Farmer's Satisfaction and Expenditure of the Vermiculture Products

ဒီသုတေသနက **စိုက်ပျိုးရေးမှာ ကြွေခွေမြေသြဇာ (vermi-fertilizers) သုံးစွဲတဲ့ လယ်သမားတွေရဲ့ ကျေနပ်မှုနဲ့ သုံးစွဲငွေ** အပေါ် လေ့လာထားတာဖြစ်ပါတယ်။

၁။ ဒေတာ စုဆောင်းခြင်း နည်းလမ်း (Data Collection Method)

- **စစ်တမ်းမေးခွန်းလွှာ (Structured Questionnaire)** ကို သုံးပြီး ကိုယ်တွေ့ မေးမြန်းခြင်း (Personal Interview) ပြုလုပ်ခဲ့ပါတယ်။
- **နှစ်ဆင့် ကျပန်း နမူနာယူနည်း (Two-Stage Random Sampling)** ကို သုံးခဲ့ပါတယ်။
    - **ပထမဆင့်:** ကျေးရွာများကို ကျပန်းရွေးချယ်ခြင်း
    - **ဒုတိယဆင့်:** ရွေးချယ်ထားတဲ့ ကျေးရွာတွေကနေ လယ်သမားများကို ထပ်မံကျပန်းရွေးချယ်ခြင်း

၂။ နမူနာအရေအတွက် သတ်မှတ်ခြင်း (Sample Size Determination)

- **လူဦးရေ (Population):** ၉၂၀ ဦး (ISSB ကုမ္ပဏီထုတ် မြေသြဇာသုံးတဲ့ လယ်သမားအားလုံး)
- **နမူနာယူသည့် ပုံသေနည်း:**

$$n = \frac{N \cdot Z^2 \cdot p(1-p)}{(N-1)d^2 + Z^2 \cdot p(1-p)}$$

- **တွက်ချက်မှုအရ:** အနည်းဆုံး နမူနာ ၂၇၁ ဦး လိုအပ်ပါတယ်။
- **အကြောင်းအမျိုးမျိုးကြောင့် ပြန်လည်မဖြေကြားနိုင်သူများအတွက် ၁၀% ထပ်ပေါင်းကာ** ၂၉၈ ဦးကို နမူနာအဖြစ် ယူခဲ့ပါတယ်။

၃။ မေးခွန်းလွှာ ဒီဇိုင်း (Questionnaire Design)

မေးခွန်းလွှာမှာ **မေးခွန်း ၂၉ ခု** ပါဝင်ပြီး အပိုင်း (၃) ပိုင်း ခွဲထားပါတယ်:

- **အပိုင်း (၁):** လူဦးရေဆိုင်ရာ အချက်အလက်များ (ကျား/မ, အသက်, ပညာရေး, အလုပ်အကိုင်)
- **အပိုင်း (၂):** စီးပွားရေးဆိုင်ရာ အချက်အလက်များ (နှစ်စဉ်ဝင်ငွေ, ကုန်ကျငွေ)
- **အပိုင်း (၃):** စိုက်ပျိုးရေးဆိုင်ရာ အချက်အလက်များ (စိုက်ပျိုးသည့်သီးနှံ, မြေဩဇာအသုံးပြုမှု)
- **အပိုင်း (၄):** ကြွေချေမြေဩဇာအသုံးပြုရခြင်း၏ အကျိုးကျေးဇူးများနှင့် ပတ်သက်၍ **ကျနပ်မှုအတိုင်းအတာ (Likert Scale)** - "လုံးဝမကျနပ်" မှ "လုံးဝကျနပ်" အထိ

၄။ ခွဲခြမ်းစိတ်ဖြာသည့် နည်းလမ်းများ (Data Analysis Methods)

သုတေသနရဲ့ ရည်ရွယ်ချက်နှစ်ခုအတွက် စာရင်းအင်းနည်းလမ်း (၃) မျိုး သုံးခဲ့ပါတယ်။

(က) ဖော်ပြချက် စာရင်းအင်း (Descriptive Statistics)

- နမူနာလယ်သမားတွေရဲ့ **လူမှုရေးနှင့် စီးပွားရေး ပကတိအခြေအနေ** (ဥပမာ- ပျမ်းမျအသက်, ပျမ်းမျဝင်ငွေ, မြေယာအကျယ်အဝန်း) ကို mean **ပျမ်းမျ, SD စံချွန်, maximum အများဆုံး, minimum အနည်းဆုံး** စတာတွေနဲ့ ဖော်ပြခြင်း။
- ရာခိုင်နှုန်း၊ ဇယားများ၊ ဂရပ်များဖြင့် ပုံဖော်ခြင်း။

(ခ) အကြောင်းရင်းများ ခွဲခြမ်းစိတ်ဖြာခြင်း (Factor Analysis)

- မေးခွန်းလွှာထဲက **ကျနပ်မှုဆိုင်ရာ အချက် ၂၃ ချက်ကို** လေ့လာပြီး ဆက်စပ်နေတဲ့ အချက်တွေကို **အုပ်စုဖွဲ့ကာ** အဓိက အကြောင်းရင်း (Factors) အဖြစ် **ခြုံငုံဖော်ထုတ်ခြင်း**။
- **ရလဒ်:** အချက် ၂၃ ချက်ကနေ **အဓိက အကြောင်းရင်း ၅ ခု** ကို ခွဲထုတ်နိုင်ခဲ့တယ်။
    1. **ပတ်ဝန်းကျင်အကျိုးကျေးဇူး (Environment)** - မြေဆီလွှာအခြေအနေတိုးတက်ခြင်း၊ ပတ်ဝန်းကျင်ကာကွယ်ခြင်း
    2. **ဝန်ဆောင်မှု (Services)** - ကုန်ပစ္စည်းပို့ဆောင်ရေး၊ ဆက်သွယ်ရေး၊ ငွေပေးချေမှု

3. **သီးနှံအရည်အသွေး (Quality of Crops)** - သီးနှံအထွက်နှုန်း၊ အရည်အသွေး၊ သိုလှောင်နိုင်မှု
4. **ဈေးနှုန်း (Price)** - ဈေးနှုန်းမျှတမှု၊ အရည်အသွေးနှင့် ကိုက်ညီမှု
5. **ဘေးကင်းလွယ်ကူမှု (Safety and Friendly Use)** - လွယ်ကူစွာအသုံးပြုနိုင်ခြင်း၊ စားသုံးသူအတွက်ဘေးကင်းခြင်း

(ဂ) များပြားသော ဆက်စပ်မှု ခွဲခြမ်းစိတ်ဖြာခြင်း (Multiple Regression Analysis)

- **ရည်ရွယ်ချက်:** လယ်သမားတွေ ကြွေခွေမြေဩဇာအတွက် **သုံးစွဲငွေ (Dependent Variable)** နဲ့ **ကျေနပ်မှုအကြောင်းရင်း ၅ ခု (Independent Variables)** တို့ကြား **ဆက်သွယ်မှုရှိ/မရှိ** လေ့လာခြင်း။
- **ပုံသေနည်း:**

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \epsilon$$

  - Y = ကြွေခွေမြေဩဇာအတွက် သုံးစွဲငွေ
  - X_1 = ပတ်ဝန်းကျင်, X_2 = ဝန်ဆောင်မှု, X_3 = သီးနှံအရည်အသွေး, X_4 = ဈေးနှုန်း, X_5 = ဘေးကင်းလွယ်ကူမှု
  - X_6 = **ထိန်းချုပ်သည့် အချက် (Control Variable)** - ကိုယ်ပိုင်မြေကော

၅။ ရလဒ်များ (Key Findings from Methodology)

- **Factor Analysis** အရ ကျေနပ်မှုအကြောင်းရင်း ၅ ခုကို ရရှိခဲ့ပြီး၊ ဒီ ၅ ခုက စုစုပေါင်း ကွဲပြားမှုရဲ့ ၆၆.၃၉% ကို ရှင်းပြနိုင်တယ်။
- **Multiple Regression** အရ **ပတ်ဝန်းကျင်အကျိုးကျေးဇူး (Environment)** နဲ့ **ကိုယ်ပိုင်မြေကော** တို့ဟာ **ကြွေခွေမြေဩဇာအသုံးပြုငွေကို သိသိသာသာ တိုးစေတယ်**။

- တစ်နည်းပြောရရင်၊ လယ်သမားတွေဟာ **ပတ်ဝန်းကျင်ကို အကျိုးပြုတယ်လို့ ယုံကြည်ရင်** နှင့် **မြေကေပိုရှိရင်** ကြွေခွေမြေသြဇာ **ပိုသုံးကြတယ်**။
- ဝန်ဆောင်မှု၊ သီးနှံအရည်အသွေး၊ ဈေးနှုန်း၊ ဘေးကင်းလွတ်ကင်းမှု တို့ကတော့ သုံးစွဲငွေအပေါ် သိသာထင်ရှားတဲ့ သက်ရောက်မှု **မရှိကြောင်း** တွေ့ရှိရတယ်။

၆။ နိဂုံးချုပ်

ဒီသုတေသနမှာ **နမူနာယူနည်း၊ ဒေတာစုဆောင်းနည်း၊ ဒေတာခွဲခြမ်းစိတ်ဖြာနည်း** အားလုံး စနစ်တကျရွေးချယ်အသုံးပြုထားပါတယ်။ **Factor Analysis** နဲ့ **Multiple Regression** ကဲ့သို့သော ခေတ်မီစာရင်းအင်းနည်းပညာများကို အသုံးပြုကာ လယ်သမားတွေရဲ့ ကျေနပ်မှုနဲ့ သုံးစွဲငွေကြေး ဆက်နွယ်မှုကို ခိုင်မာစွာ ရှာဖွေနိုင်ခဲ့ပါတယ်။

Factor Analysis (အကြောင်းရင်း ခွဲခြမ်းစိတ်ဖြာမှု) အကြောင်း

ဒီနည်းလမ်းကို ဒီသုတေသနမှာ **လယ်သမားတွေရဲ့ ကျေနပ်မှုအကြောင်းရင်းတွေကို စုစည်းဖော်ထုတ်ဖို့** သုံးခဲ့တာဖြစ်ပါတယ်။

Factor Analysis ဆိုတာ ဘာလဲ ?

ရိုးရိုးရှင်းရှင်းပြောရရင် - ကိစ္စတစ်ခုအပေါ် လူတွေ ဘယ်လိုတွေးလဲဆိုတဲ့ **မေးခွန်းအများကြီး (Variables)** ကို **အဓိကအကြောင်းရင်း (Factors) အနည်းငယ်ထဲ ခြုံငုံဖော်ထုတ်တဲ့ နည်းလမ်း** ဖြစ်ပါတယ်။

ဥပမာ - ကျောင်းသား ၁၀၀ ကို သင်္ချာနဲ့ပတ်သက်တဲ့ မေးခွန်း ၅၀ မေးလိုက်တယ်။ Factor Analysis သုံးပြီး ခွဲကြည့်တဲ့အခါ ဒီမေးခွန်း ၅၀ ကို **"ဂဏန်းစဉ်းစားနိုင်စွမ်း"**၊ **"ဂျီသြမေတြီပိုင်းဆိုင်ရာ ကွင်းဆက်ကောက်နိုင်စွမ်း"** ဆိုတဲ့ အကြောင်းရင်း ၂ ခုအောက်ကို ခြုံငုံလိုက်နိုင်တာမျိုးဖြစ်ပါတယ်။

Factor Analysis ကို ဘာ့ကြောင့် သုံးတာလဲ ?

၁။ **ဒေတာရိုးရှင်းအောင် လုပ်ဖို့ (Data Reduction)**

- မေးခွန်း ၂၃ ခုလုံးကို တစ်ခုချင်းစီ ခွဲကြည့်နေရင် ရှုပ်ထွေးတယ်။
- Factor Analysis က **ဆက်စပ်နေတဲ့ မေးခွန်းတွေကို အုပ်စုဖွဲ့** ပေးလိုက်တော့ အဓိက အကြောင်းရင်း ၅ ခုပဲ ကြည့်ရုံနဲ့ ရှင်းသွားတယ်။

၂။ **ပုန်းကွယ်နေတဲ့ အကြောင်းရင်းတွေကို ရှာဖွေဖို့ (To identify latent constructs)**

- "ကျေနပ်မှု" ဆိုတာ မျက်စိနဲ့ မြင်လို့မရဘူး။ ဒါပေမယ့် သူ့ကို "ဝန်ဆောင်မှု ကျေနပ်မှု"၊ "ဈေးနှုန်း ကျေနပ်မှု" စတဲ့ **အကြောင်းရင်းခွဲတွေအဖြစ် တိုင်းတာလို့ရတယ်**။
- Factor Analysis က ဒီ **ပုန်းကွယ်နေတဲ့ အကြောင်းရင်းတွေကို ဖော်ထုတ်ပေးတယ်**။

Factor Analysis လုပ်ဆောင်ပုံ အဆင့်ဆင့်

ဒီသုတေသနထဲက ဥပမာနဲ့တကွ ရှင်းပြပါမယ်။

အဆင့် ၁: စစ်ဆေးမှုများ ပြုလုပ်ခြင်း

Factor Analysis လုပ်ဖို့ သင့်/မသင့် အရင်စစ်ရတယ်။

- **KMO Test (Kasier-Meyer-Olkin Measure):**
  - **ဘာကို စစ်တာလဲ?** ဒေတာတွေက Factor Analysis လုပ်ဖို့ **ကောင်းမွန်ရဲ့လား** ဆိုတာကို စစ်ဆေးတာ။
  - **ရလဒ်:** 0.873 ရတယ်။ (0.9 နားဆို သိပ်ကောင်းတယ်၊ 0.5 အောက်ဆို မကောင်းဘူး)
  - **ဆိုလိုရင်း:** ဒေတာတွေက Factor Analysis လုပ်ဖို့ **အကောင်းဆုံးနီးပါး** ဖြစ်နေတယ်။
- **Bartlett's Test of Sphericity:**

- **ဘာကို စစ်တာလဲ ?** မေးခွန်းတွေကြားမှာ **ဆက်သွယ်မှု (Correlation)** ရှိရဲ့လား။ ဆက်သွယ်မှုမရှိရင် Factor Analysis လုပ်လို့မရဘူး။
- **ရလဒ်:** p-value = 0.000
- **ဆိုလိုရင်း:** မေးခွန်းတွေကြားမှာ **ဆက်သွယ်မှုရှိတယ်**၊ Factor Analysis လုပ်လို့ရတယ်။

အဆင့် ၂: အကြောင်းရင်းများ ထုတ်ယူခြင်း (Extraction)

ကွန်ပျူတာက ဒေတာတွေကို ခွဲခြမ်းစိတ်ဖြာပြီး **ဘယ်နှစ်ခုသော အကြောင်းရင်းတွေ ရှိသလဲ** ဆိုတာ ဆုံးဖြတ်ပေးတယ်။

- **Eigenvalue** ဆိုတဲ့ ကိန်းကို သုံးတယ်။ **Eigenvalue 1.0 ထက် ကြီးတဲ့ အကြောင်းရင်းတွေကို ယူတယ်**။
- ဒီသုတေသနမှာ **Eigenvalue > 1.0** ဖြစ်တဲ့ အကြောင်းရင်း **၅ ခု** ထွက်လာတယ်။

အဆင့် ၃: အဓိပ္ပာယ်ဖွင့်ဆိုခြင်း (Interpretation)

Rotated Component Matrix လို့ခေါ်တဲ့ ဇယားကြီးထဲမှာ **Factor Loading** လို့ခေါ်တဲ့ ကိန်းဂဏန်းတွေ ပါလာတယ်။

- **Factor Loading ဆိုတာ ဘာလဲ ?** ဒီမေးခွန်းက ဘယ်အကြောင်းရင်းနဲ့ **ဘယ်လောက်ဆက်စပ်သလဲ** ဆိုတဲ့ ပြင်းအားကို ပြတယ်။
- **ဘယ်လိုကြည့်မလဲ ?**
  - **Factor Loading မြင့်ရင်** ဆက်စပ်မှုများတယ်။
  - **Factor Loading နိမ့်ရင်** ဆက်စပ်မှုနည်းတယ်။
  - **ဥပမာ:** "Make soil quality for long term use" ဆိုတဲ့မေးခွန်းမှာ **Factor 1** အတွက် Loading 0.895 ရှိတယ်။
  - **ဆိုလိုရင်း:** ဒီမေးခွန်းက **Factor 1** နဲ့ **အလွန်ပဲဆက်စပ်နေတယ်**။

ဒီလိုနဲ့ မေးခွန်း ၂၃ ခုကို ကြည့်ပြီး **ဆက်စပ်မှုအရှိဆုံး အကြောင်းရင်းခွဲတွေအောက်မှာ စုစည်းပြီး အမည်ပေးကြတယ်။**

ဒီသုတေသနမှာ ရတဲ့ Factor (၅) ခု

၁. **ပတ်ဝန်းကျင် (Environment)**

- မြေဆီလွှာအခြေအနေ တိုးတက်စေခြင်း
- မြေဆီလွှာ ပျက်စီးမှု ကာကွယ်ခြင်း
- ပိုးမွှားဘေးက ကာကွယ်ပေးခြင်း
- လေထု သန့်ရှင်းစေခြင်း

၂. **ဝန်ဆောင်မှု (Services)**

- ရောင်းချသူနှင့် အသုံးပြုသူကြား ဆက်သွယ်ရေး
- သယ်ယူပို့ဆောင်ရေး အဆင်ပြေခြင်း
- ကုန်ပစ္စည်း အချိန်မီရရှိခြင်း
- ငွေပေးချေမှု စနစ်

၃. **သီးနှံအရည်အသွေး (Quality of Crops)**

- မျိုးစေ့အရည်အသွေး တိုးတက်ခြင်း
- ထုတ်ကုန်အရည်အသွေး တိုးတက်ခြင်း
- အထွက်နှုန်း တိုးတက်ခြင်း
- အရောင်အသွေး ကောင်းမွန်ခြင်း
- သိုလှောင်သက်တမ်း ရှည်ကြာခြင်း

၄. **ဈေးနှုန်း (Price)**

- ဈေးနှုန်း မျှတခြင်း
- အရည်အသွေးနှင့် ကိုက်ညီခြင်း

၅. **ဘေးကင်းလွယ်ကူမှု (Safety and Friendly Use)**

- စားသုံးသူအတွက် ဘေးကင်းခြင်း
- အသုံးပြုရန် လွယ်ကူခြင်း

အိမ်မက်နဲ့ ဥပမာ

စိတ်ကူးယဉ်ကြည့်ပါ... ကားအသစ်တစ်စီး ဝယ်ချင်တယ်။ ကားအကြောင်း **အင်တာနက်မှာ Review ၅၀ ခု** ဖတ်လိုက်တယ်။

Review ၅၀ ခုလုံးကို ဖတ်ပြီး ခေါင်းရှုပ်သွားတယ်။ Factor Analysis သုံးပြီး ခွဲကြည့်လိုက်တဲ့အခါ...

- **Factor 1: လောင်စာချွေတာမှု** - Review ၁၅ ခုက ဒီအကြောင်းပြောနေတာ။
- **Factor 2: စက်ပစ္စည်းယန္တရား ခိုင်မာမှု** - Review ၁၂ ခုက ဒီအကြောင်းပြောနေတာ။
- **Factor 3: အဆင်ပြေလွယ်ကူမှု** - Review ၈ ခုက ဒီအကြောင်းပြောနေတာ။

ဒီတော့... Review ၅၀ ခုလုံးကို မဖတ်တော့ပဲ **အဓိက အကြောင်းရင်း ၃ ခုကိုပဲ ဆုံးဖြတ်ချက်ချလိုက်တာ**။ ဒါဟာ Factor Analysis ရဲ့ သဘောပါပဲ။

အကျဉ်းချုပ်

Factor Analysis ဟာ **ဒေတာအများကြီးကို အဓိကအကြောင်းရင်း အနည်းငယ်ထဲ ခြုံငုံပြီး ရှင်းလင်းအောင်၊ နားလည်အောင် လုပ်ဆောင်ပေးတဲ့ စက်ရုပ်ကြီးတစ်ရုပ်** လို့ မှတ်လိုက်ပါ။ ဒီသုတေသနမှာဆိုရင် လယ်သမားတွေရဲ့ ကျေနပ်မှုဆိုင်ရာ မေးခွန်း ၂၃ ခုကို ခြုံငုံပြီး အဓိကအကြောင်းရင်း ၅ ခုအဖြစ် ဖော်ထုတ်ပေးနိုင်ခဲ့တာပါ။

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MASTER OF APPLIED STATISTICS PROGRAMME

FARMER'S SATISFACTION AND EXPENDITURE OF THE VERMICULTURE PRODUCTS

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This is to certify that this dissertation entitled "FARMER'S SATISFACTION AND EXPENDITURE OF THE VERMICULTURE PRODUCTS" submitted as the requirement for the Degree of Master of Applied Statistics has been accepted by the Board of Examiners.

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ABSTRACT

In this study, farmer's satisfaction and expenditure of the vermi-fertilizers was analyzed. The purpose of this study is to investigate the farmers' satisfaction on the effect of using vermi-fertilizers, the knowledge on the advantages of vermi-fertilizers to reduce using chemical fertilizer. Appropriate statistical analysis such as descriptive statistics, factor analysis and multiple regression analysis are used in this study. The data were collected using a structured questionnaire. The total 298 respondents were selected by random sampling method; proportional allocation approach and personal interview method were used in this study. By factor analysis, there are five factors of satisfaction, environment, services, quality of crops, price, friendly and safety used. The findings of the study show that there is positive relation between the expenditure on vermi-fertilizers and the factor of environment and the control variable of farmers' own land acres. Finally, as for a practical implication, farmers satisfaction on the environment factor when using vermi-fertilizers. On the other hand, services, quality of crops, price and safety and friendly use were the reasons given by dissatisfied farmers.

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CONTENTS

ABSTRACT			**i**
ACKNOWLEDGEMENT			**ii**
CONTENTS			**iii**
LIST OF TABLES			**v**
LIST OF FIGURES			**vi**
LIST OF ABBREVIATIONS			**vii**
			PAGE
CHAPTER	**I**	**INTRODUCTION**	**1**
	1.1	Rationale of the Study	1
	1.2	Objectives of the Study	3
	1.3	Method of Study	3
	1.4	Scope and Limitations of the Study	4
	1.5	Organization of the Study	4
CHAPTER	**II**	**LITERATURE REVIEW AND BACKGROUND**	**5**
	2.1	Bio-Fertilizers	5
	2.2	Vermi-Compost	5
	2.3	The Benefits of Vermi-compost and Vermi-Liquid	6
	2.4	Organic Agricultural Areas in Myanmar	7
	2.5	Myanmar Fertilizer Consumption Per Unit of Arable Land	8
	2.6	Review on Relative Studies	10
	2.7	Conceptual Framework of the Study	13
CHAPTER	**III**	**RESEARCH METHODOLOGY**	**15**
	3.1	Survey Design	15
	3.2	Sample Size Determination	15
	3.3	Questionnaire Design	16
	3.4	Factor Analysis	17
		3.4.1 Testing of Sampling Adequacy of the Approach	17
		3.4.2 Reliability Analysis	18
	3.5	Regression Analysis	19

	3.5.1	Simple Linear Regression Model	19
	3.5.2	Ordinary Lease Square Estimates (OLS)	20
	3.5.3	Assumptions Underlying the Simple Regression Model	21
	3.5.4	Multiple Linear Regression Model	23
	3.5.5	Assumptions of the Multiple Linear Regression Model	24
	3.5.6	Multicollinearity	25
CHAPTER IV		**ANALYSIS OF FACTOR AND MULTIPLE REGRESSION FOR EXPENDITURE ON FARMERS' SATISFACTION**	**26**
4.1		Profiles of the Respondents	26
	4.1.1	Demographic Characteristics of the Respondents	26
	4.1.2	Socio-Economic Characteristics of the Respondents	30
	4.1.3	Plantation of Crops	33
	4.1.4	Utilization of Fertilizers	34
4.2		Factor Analysis for Farmers' Satisfaction	38
4.3		Multiple Regression Model	41
4.4		Correlation Analysis `	42
4.5		Results of Multiple Regression Analysis	43
4.6		Testing for Normality of Disturbances	46
4.7		Testing for Homoscedasticity of Disturbances	47
4.8		Testing for Multicollinearity	47
CHAPTER V		**CONCLUSION**	**48**
5.1		Findings	48
5.2		Suggestions and Recommendations	51
5.3		Further Studies	52

REFERENCES

APPENDICES

LIST OF TABLES

TABLE **PAGE**

(2.1) Organic Agricultural Areas in Myanmar 8

(2.2) Myanmar Fertilizer Consumption per Unit of Arable Land 9

(2.3) Absolute Values in Metric Ton 10

(3.1) Sample Size Allocation 16

(3.2) Kasier-Meyer-Olkin (KMO) and Bartlett's Test 18

(4.1) Gender of the Respondents 27

(4.2) Race of the Respondents 27

(4.3) Religion of the Respondents 27

(4.4) Age of the Respondents 28

(4.5) Household Member of the Respondents 29

(4.6) Education of the Respondents 30

(4.7) Occupation of the Respondents 31

(4.8) Annual Income of the Respondents 32

(4.9) Types of Crops and Information Sources of Crops 34

(4.10) Using Vermi-Fertilizer of Respondents 35

(4.11) Average, Standard Deviation, Minimum and Maximum of the Respondents' Planted Land Area 36

(4.12) Average, Standard Deviation and Maximum of the Respondents' Used on Vermi-fertilizers 37

(4.13) Average, Standard Deviation, Minimum and Maximum of the Expenditure on Vermi-fertilizers 38

(4.14) Kaiser-Meyer-Olkin (KMO) and Bartlett's Test 39

(4.15) Reliability 39

(4.16) Pearson Correlation Between Spent on Vermi-fertilizers for One Season and Selected Six Sectors 43

(4.17) Multiple Regression Model Summary 43

(4.18) Analysis of Variance (ANOVA) for Multiple Regression Model 44

(4.19) Coefficients of Factor Score for the Selected Factors 45

(4.20) Multicollinearity of the Selected Factors 47

LIST OF FIGURES

FIGURE		PAGE
(2.1)	Conceptual Framework for the Expenditure on the Satisfaction Factors	14
(4.1)	Gender of the Respondents	27
(4.2)	Age of the Respondents	28
(4.3)	Household Members of the Respondents	29
(4.4)	Education of the Respondents	30
(4.5)	Occupation of the Respondents	31
(4.6)	Annual Income of the Respondents	32
(4.7)	Scree Plot	40
(4.8)	Histogram for Residuals of Satisfaction of Vermi-fertilizers	46
(4.9)	P-P Plot of Regression Residuals of Satisfaction of Vermi-fertilizers	46
(4.10)	Scatterplot of Residual Against Predicted Values	47

LIST OF ABBREVIATIONS

ANOVA	-	Analysis of Variance
CGPA	-	Cumulative Grade Point Average
CLRM	-	Classical Linear Regression Model
FAO	-	Food and Agriculture Organization
FYM	-	farmyard Manure
GAP	-	Good Agriculture Practices
HH	-	Household
ISSB	-	Integrated Swanyee Social Business
KMO	-	Kasier – Meyer-Olkin
MH	-	Million Hectares
MMK	-	Myanmar Kyat Currency
OLS	-	Ordinary Lease Square
RSS	-	Residual Sum of Square
TIN	-	Total Inorganic Nitrogen
VC	-	Vermicompost
VIF	-	Variance Inflation Factor

CHAPTER I

INTRODUCTION

1.1 Rationale of the Study

All the nutrients in our food originally come from the soil. In order to create healthy crops for sufficient nutrients, farm needs healthy soil. Soils has naturally contented many nutrients like nitrogen, phosphorous, calcium, and potassium, which allow plans to grow. If soil nutrients are missing or in short supply, plants get nutrient deficiency and impact to growing stop. The plant cannot function properly and produce the food necessary to feed the worlds' population, when the nutrient level is too low. It needs to acquire essential nutrients from many different food sources for human. It was need to keep soils healthy and full of nutrients in order to feed the growing population. Sustainable agriculture produces enough food and fiber to satisfy changing human needs while conserving natural resources, maintaining the quality of environment and ultimately leading to community and gender equity.

Fertilizers are used daily by farmers and families to help crops and gardens grow. Whether it is a small garden of flowers and plants, or a large one with thousands of acres of crops, a wide range of fertilizers have been utilized to help different crops growing in different soil and weather conditions.

Myanmar is a major agricultural country, with a wide range of crops, perennials, forests can be grown extensively in this country. The use of natural resources for agricultural production has been long a traditional practice of farmers in Myanmar. Agricultural production was solely dependent on the use of farmyard manure (FYM) and locally available organic manures, prior to the introduction of chemical fertilizers in the late 1900s. When chemical fertilizers were introduced in the late 1900s, there were dramatic increase in crop yields. Verities of high yielding introduction also make improvement of crop yields.

Farmers are using chemical fertilizer for the long time to their crops to get yield increase. Since fertilizer used by farmers has been considerably less than recommended, and because of the nutrient needs of varieties of high yielding, there has been a substantial depletion of plant nutrients from soil. And it gets result in a critical decline in soil fertility and productivity. It makes farmers more costly and

difficult to cope in the vicious cycle. As much of using the chemical fertilizers in the long-term impacts: the environmental and soil degradation.

Using of chemical fertilizers gets the biggest issue in groundwater contamination. Nitrogen fertilizers break down into nitrates and travel easily through the soil as it is water-soluble and can remain in groundwater for decades, and there is accumulative effect as the addition of more nitrogen over the years in the soil. Due to release of nitrous oxide by denitrification process, one popular fertilizer, urea, produces ammonia emanation, contributes to acid rain, groundwater contamination and ozone depletion. With its increased use and projections of future use, this problem may increase several folds in the coming decades. Groundwater contamination has been linked to gastric cancer, goiter, birth malformations, and hypertension; testicular cancer and stomach cancer. It may cause respiratory ailments, cardiac disease, and several cancers, as well as can "inhibit crop growth, increase allergenic pollen production, and potentially affect the dynamics of several vector-borne diseases, including West Nile virus, malaria, and cholera", because of excessive air- and water-borne nitrogen from fertilizers.

Normally bio fertilizers are usually eco-friendly and also guard the particular ecosystem in opposition to pollution. Bio fertilizers reduce and eliminate people damaging parts from the earth which usually result in conditions inside the crops. Through the use of resource fertilizers, crops can be safeguarded in opposition to drought as well as other stringent ailments. Bio fertilizers usually cheap and also poor farmers can easily utilize these. They help acquire large produce regarding vegetation by creating the particular earth abundant togethering with vitamins and minerals and also microbes which required for the particular progress with the crops. Bio fertilizer make increase the actual and also substance attributes regarding earth. Bio fertilizers are low cost, renewable sources of plant nutrients and gaining momentum recently due to the increasing emphasis on maintenance of soil health, minimize environmental pollution and cut down on the use of the chemicals in agriculture.

It makes farmers getting to recognize that the problem of declining soil fertility, when crops do not get yield as much as expected, However, the restoration of soil fertility in most cases has not been achieved. Increasing cost and uncertain availability of chemical fertilizers in the developing countries make for the higher production costs.

It should be made to decrease the dependency on expensive and even hazardous chemical inputs, and try to get efforts to increase agricultural production and the fertility of nutrients by using natural fertilizer and bio fertilizers. It will have more effective ways and means of using natural resources would undoubtedly help to improve agricultural production in Myanmar. Farmers need to use bio fertilizers to protect environmental and healthy life of farmers and consumers, so it needs to study the satisfaction of the farmers on the advantages of bio fertilizers so that to get the sustainable agriculture and development.

Therefore, the satisfaction of the farmers who using the vermi-fertilizers which is one of the bio fertilizers and the advantages of using vermi-fertilizers as for agriculture inputs was analyzed in this study.

1.2 Objectives of the Study

The objectives of the study are

(1) To explore the farmers' satisfaction factors on using vermi-fertilizers

(2) To examine the relationship between expenditure on vermi-fertilizers and the satisfaction factors on the use of vermi-fertilizers.

1.3 Method of Study

The required data for studying farmers' satisfaction on using vermi-fertilizers has been obtained by conducting a sample survey. Two-stage random sampling was used to select villages and farmers.

The study has been focused on identifying the advantages attributes which influence farmers' satisfaction. Therefore, statistical analysis such as descriptive method, factor analysis and multiple regression analysis were used to meet the objectives of study.

1.4 Scope and Limitations of the Study

Farmers' satisfaction on the use of vermi-fertilizers which is produced by Integrated Swanyee Social Business Company Limited has been analyzed by using factor analysis and multiple regression analysis based on the primary survey data at 5 selected townships in Magway Division. The townships are the project area of ISSB company.

For the analysis of vermi-fertilizers is based on the available information from Integrated Swanyee Social Business Company Limited, literatures studies and statistical records from various publications for statistical analysis. There is a limitation, there are many types of bio fertilizer in Myanmar. Among them, vermi-fertilizers has been studied in this research.

1.5 Organization of the Study

This study consists of five chapters. Chapter I is the introduction in which rationale, objectives, scope and limitations, method and organization of the study are included. Chapter II includes literature reviews and historical background of bio fertilizer. Chapter III presents Research methodology which has been described Factor analysis, Multiple regression analysis. Chapter IV discusses the descriptive analysis, factor analysis and multiple regression analysis. Chapter V summarizes the conclusion.

CHAPTER II

LITERATURE REVIEW AND BACKGROUND

2.1 Bio-Fertilizers

Bio-fertilizers are live formulates of microorganisms that are ready to be used and improve the quality and the health of the soil and the plant species by increasing the nutrient availability for the soil, seeds and roots. Bio-fertilizers naturally activate the microorganisms found in the soil restoring the soil's natural fertility and protecting drought and soil diseases, and therefore stimulate plant growth.

Nitrogen bio-fertilizers - Nitrogen bio-fertilizers help to correct the nitrogen levels of the soil. Nitrogen is a limiting factor for plant growth because plants need a certain amount of nitrogen in the soil to thrive. Different bio-fertilizers have the optimum effect for different soils, so the cultivated crop determines what type of nitrogen bio-fertilizer should be used.

Phosphorus bio-fertilizers - Just like nitrogen, phosphorus is also a limiting factor for plant growth. Phosphorus bio-fertilizers help the soil to reach its optimum level of phosphorus and correct the phosphorus levels of the soil. Unlike nitrogen bio-fertilizers, the usage of phosphorus bio-fertilizers is not dependent on the crops cultivated on the soil.

Compost bio-fertilizers – Compost bio-fertilizers help to reduce the bacterial processes breaking down the compost waste. Suitable bio-fertilizers for compost use are Cellulolytic fungal culture and Phosphotika and Azotobacter cultures.

2.2 Vermi-Compost

Vermiculture products which is the product of the composting process which used for plants to increase soil quality and strength of the plants. The process in which various species of worms, usually red wigglers, white worms, and other earthworms to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast.

2.3 The Benefits of Vermi-Compost and Vermi-Liquid

Vegetable waste is converted by using of the earthworms to make vermicompost 100 percent natural plant fertilizer. Vermiculture is made as the side issue of the breeding of common earthworms for use in vermicomposting. The use of worm farms for vermicomposting is changed a favorite way of converting waste to a valuable product while also growing more worms to increase the capacity of the worm farms.

It is 100 percent organic produced by earthworms is that the most important aspect of compost. It does not need to be mixed with anything as there are no harmful chemicals in the vermicompost.

Vermicomposting produces a product as naturally designed to benefit plants in several different ways. The nutrients in earthworm compost are very easily absorbed by the roots of plants, and this is the most significant benefit of the vermicompost. Unlike chemical fertilizers, the worm contain mucus and it make vermicompost not to be easily flushed from the soil, and plants get the maximum benefit for longer the nutrients.

It helps plants to become more disease resistant and also repel some plant pests as the compost is passing through the body of the worms, it is enriched with bacteria and microbes. The presence of increased microbial activity can change the area much more attractive to birds which also help to remove plant pests.

The need for pesticides is reduced as the compost works on the plants and they become healthier, the reduction in pesticides helps the area to recover faster and can start an improvement cycle that will run on. This compares with the typical cycle when chemical fertilizers are used. Although the chemical fertilizers might increase plant yields, they do nothing for plant health. Continued use of chemical fertilizers inevitably leads to a breakdown in the soil. Ammonia and salts build up which attack the plants making them less able to withstand disease.

Among the hormones which earthworm compost contains are hormones that help plants to grow. Germination of seeds is encouraged; the growth of the plant is stronger and the crop yield improved. This natural support for the plants is not available in the chemical fertilizers. The distribution of the compost into the soil also helps to encourage healthy of root growing.

Vermicompost is a colloid and holds up to nine times its own weight in water. This can change a huge difference when there is a dry spell. The water is held at an organic level so tends to evaporate slowly while still being available to the plants.

Chemical fertilizers bombard plants with huge amounts of nutrients that are going to drain by and eventually be washed out of the soil by the rain. The chemicals can get into the aquifers and contaminate your drinking water. This can be avoided by using a compost which is lower in nutrient content, but which does not get washed out of the soil. The nutrients are held in place and released slowly so that the plants receive what they need over a prolonged period.

Using earthworms creates natural product and behaves naturally. The cycle of regularly over-dosing the soil is broken. Plant health is improved by long-term exposure to nutrients and the soil condition will continue to be improved.

2.4 Organic Agricultural Areas in Myanmar

In 2017, agricultural area for Myanmar was 12,871 thousand hectares. Agricultural area of Myanmar increased from 10,768 thousand hectares in 1968 to 12,871 thousand hectares in 2017 growing at an average annual rate of 0.37%. Agricultural area, this category is the sum of areas under “Arable land and Permanent crops” and “Permanent pastures”.

In 2017, agricultural area organic for Myanmar was only 10 thousand hectares. Agricultural area organic of Myanmar increased from 0 thousand hectares in 2011 to 10 thousand hectares in 2017 growing at an average annual rate of 158.25%.

Australia has the largest organic agricultural Land (35.65 million hectares) in the world. China has the organic agricultural land (3.02 million hectares), and India has 1.78 million hectares in Asia in 2017. The ten countries with the largest areas of organic agricultural land in 2017 are Australia (35.65 million hectares), Argentina (3.39 MH), China (3.02 MH), Spain (2.08 MH), United States of America (2.03 MH), Italy (1.91 MH), Uruguay (1.88 MH), India (1.78 MH), France (1.74 MH) and Germany (1.37 MH) according to the record in 2017.

Table (2.1) Organic Agricultural Areas in Myanmar

Year	Agricultural Area		Agricultural Area Organic	
	Value (thousand hectares)	Percent Change (%)	Value (thousand hectares)	Percent Change (%)
2005	11,263	-	-	-
2006	11,597	2.97	-	-
2007	11,984	3.34	-	-
2008	12,277	2.44	-	-
2009	12,441	1.34	1	-
2010	12,526	0.68	0	-89.09
2011	12,558	0.26	0	233.33
2012	12,549	-0.07	1	350.00
2013	12,587	0.30	1	0.00
2014	12,632	0.36	5	488.89
2015	12,749	0.93	6	5.66
2016	12,760	0.09	5	-17.86
2017	12,871	0.87	10	122.83

Source: World data atlas; Knoema Enterprise Data Solutions (2017)

2.5 Myanmar Fertilizer Consumption Per Unit of Arable Land

Fertilizer consumption measures the quantity of plant nutrients used per unit of arable land. Fertilizer products cover nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate). Traditional nutrients--animal and plant manures--are not included. For the purpose of data dissemination, FAO has adopted the concept of a calendar year (January to December). Some countries compile fertilizer data on a calendar year basis, while others are on a split-year basis. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted

once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded.

Myanmar fertilizer consumption was at level of 17.9 kilograms per hectare in 2016, down from 23.8 kilograms per hectare previous year, this is a change of 24.96 percent.

Table (2.2) Myanmar Fertilizer Consumption Per Unit of Arable Land

Year	Value (Kilograms per hectare)	Percent Change (%)
2005	6.5	-
2006	9.0	38.26
2007	15.8	74.94
2008	7.6	-51.75
2009	6.2	-18.05
2010	6.6	6.43
2011	15.0	125.93
2012	15.6	4.27
2013	19.5	24.92
2014	24.4	25.09
2015	23.8	-2.51
2016	17.9	-24.96

Source: World data atlas; Knoema Enterprise Data Solutions (2017)

Table (2.3) Absolute Values in Metric Ton

Year	Urea	T-Super	Potash	Compound	Other	Total
2005-2006	5912	2092	1302	2456	-	11762
2010-2011	4588	171	182	766	-	5707
2013-2014	22597	11900	5449	29935	5087	74968
2014-2015	10431	5208	2492	8304	2007	28442
2015-2016	1114596	165245	58297	1033221	56114	2427473
2016-2017	1321267	201990	62864	1493423	87798	3167342
2017-2018	1546037	270841	141283	1394478	131158	3483797

Source: Myanmar Statistical Yearbook (2018)

2.6 Review on Relative Studies

Peter Dalton Austin (2015) presented that "An evaluation of vermi-compost as a fast-acting nitrogen amendment to mitigate deficiencies in organic vegetable production." In this study, statistical techniques have been used ANOVA for the plant analyses. ANOVA was also used for the soil fertility measurements and soil water measurements. When ANOVA indicated differences among treatments differences were tested in the means using t-tests. A linear regression analyzing the aboveground height at harvest was performed to determine the correlation between height at harvest and fresh marketable yield. It is showed that the results from Experiment 1, as the plant production was dramatically increased both in the greenhouse as well as subsequently in the field for vermicompost treatments and directly correlates to economic differences. Results from Experiment 2 can be learnt that plant production differences between compost treatments vary by site. There was no significant

difference in soil and soil water NO3-N, NH4-N and Total Inorganic Nitrogen (TIN) among treatments, site or experiment. The timely rate of plant development in greenhouse started VC treatments shows as the great potential to be the first to market with fresh produce when other treatments are still waiting to transplant.

Moe Moe (2014), Yangon University of Economics, presented that "Organic Fertilizers utilization in Nyungdon Township." In this study, the study identified the organic fertilizers utilization practices among farmers at the study area in Myanmar and suggested appropriate practical steps to farmers in moving towards sustainable agriculture in Myanmar. The method applied is the descriptive method and random sampling. The research design adopted in this study was field survey using structured questionnaires and data were analyzed by using frequency counts and percentages to achieve objectives. Cow dung and crop residues were used as organic fertilizers and there were no compost making at the study area. The amount of cow dung used was based on the number of cattle owned, land preparation method, cropping patterns used by farmers in the study area. The land preparation methods are changed by using from cattle (3%). Double cropping pattern was practiced and monsoon rice- pea areas were larger than others. The less use of cattle affects scarcity of cow dung and less application of organic fertilizers in their filed. Farmers use imbalanced chemical fertilizers application. The cost benefit ration of mungbean, summer rice, monsoon rice and groundnut were 2.39, 2.13, 2.04 and 1.98 respectively. Organic fertilizers production and utilization should be encouraged and locally appropriate and user-friendly compost making technology should be identified and tested in farmer level and balanced fertilizers applications should be applied for high yielding and for soil fertility improvement enhancing the development of sustainable agriculture.

Nyan Lin (2015) presented that 'Organic Farming in Myanmar'. In this study, the study intends to realize the impacts of organic farming in Myanmar and other countries especially in Asia, Europe, Africa and Dental America. The method used in this study is mainly a descriptive method with development approach of research employing secondary in available data sources. The study will cover the period 2004 to 2012. The result tends to contribute to become positive change on sustainable land use and resource management in agriculture. The responses indicate that control of weeds, insects, disease; uncertain about economic returns; and complication of the

process of becoming an organic producer are the most important barriers for starting organic farming.

Hassan et. al. (2011) presented that “Using Factor Analysis on Survey Studies of Factors Affecting Students’ Learning Styles”. This study is focused on the statistical technique of using the factor analysis on constructing the new factors affecting students’ learning styles of the survey done among university students. Moreover, comparison make the meaning of using the Kruskal-Wallis test were done to analyze the demographic differences on the new factors affecting students’ learning styles. The data were collected using survey questionnaires. The number of respondents reached 189 students. The methodologies used were descriptive statistics, factor analysis and non-parametric technique using the Kruskal-Wallis test. The results are showed seven new factors which were successfully constructed using factor analysis and assigned as the factors affecting the learning styles; which are 1) students' attitude before and after attending class, 2) strategies used to comprehend the lecture, 3) the importance of lecture, 4) class size and its condition, 5) efforts outside class, 6) classroom convenient and 7) importance on listening to lecture. The Kruskal-Wallis test results showed there was a significant mean difference between gender on students' efforts outside class (factor 5) while there was no significant mean of difference between genders on the other factors of students’ learning style. As for the years of study, Kruskal-Wallis test showed that students’ attitude before and after attending class influenced learning style. The result from Kruskal Wallis test showed different in score for science and non-science stream students. Non-science students have a better comprehend strategy as their field could be practiced outside classroom and do not merely based on theory. On the other hand, science students satisfy with their class size and its condition as compared to non-science students. The result shows that CGPA is only influenced by the importance of class size and its condition and the importance of lecture. Students with CGPA 2.00-2.49 indicated that attending lecture is crucial and satisfy with classroom size and its condition as compared to students with another group of CGPA.

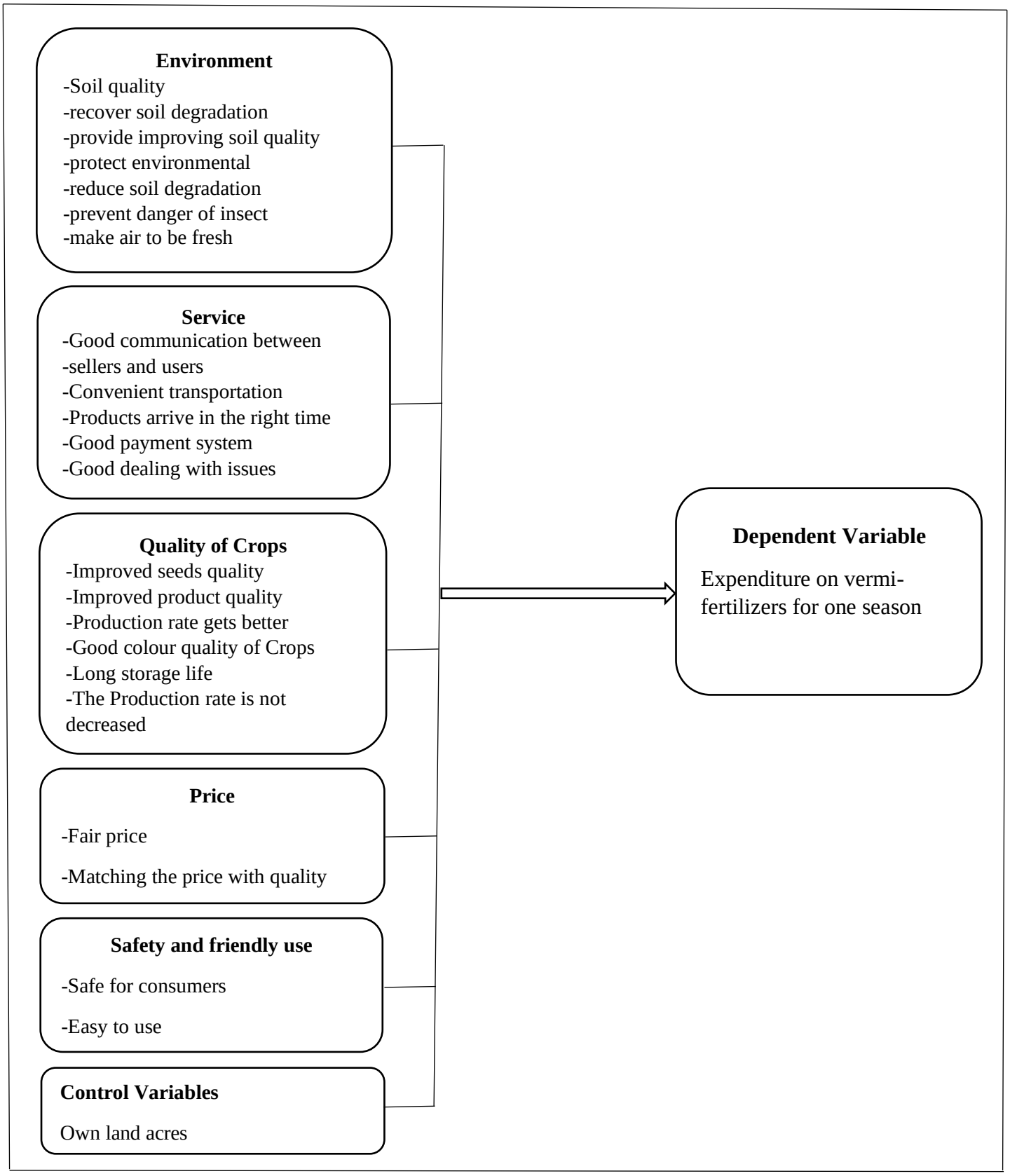
Jurdana and Frleta (2016) presented that “Factors affecting the Expenditure of Domestic and Foreign tourist – The Evidence from Rijeka and Opatija, Coratia”. The purpose of this research analyzed tourist expenditure determinants using a survey of domestic and foreign tourists visiting Rijeka and the Opatija Riviera during summer

2014. The differences investigated between domestic and foreign tourist expenditures (both daily expenditure and total expenditure during the whole stay). The other aim was determined the impact of a set of relevant control variables on daily tourist expenditure in the destination, separately for domestic and foreign tourists. Tourist characteristics and trip-related variables are used identified the determinants of expenditures. And tourist satisfaction levels were included in the models as explanatory variables. Descriptive statistical analysis was performed on the socioeconomic, demographic, travel and attitudes-related variables to obtain frequencies. Simple linear regression was performed to test for statistically significant differences between domestic and foreign tourist expenditures. Multiple regression analyses were carried out separately on domestic and foreign respondents to determine what factors affect their respective expenditure. The findings provided evidence of the differences in expenditure between domestic and foreign tourists as well as the existence of different determinants of their daily expenditure levels. The study provides valuable information for tourism management since it reveals the type of tourists that have a higher economic impact on a destination. Research results served as guidelines for modifying tourism management and marketing policies, strategies and plans in order to attract the most interesting type of tourists and ensure their repeat visits.

2.7 Conceptual Framework of the Study

The conceptual framework demonstrates the inter-linkage among the independent and dependent variables. This study which shows the inter-linkage between “the satisfaction factors which are environment, services, quality of crops, price, safety and friendly use and own land acres” and dependent variable “the expenditure on vermi-fertilizers”. The following figure presents the framework which displays dependent variable and independent variables utilized in the study.

Figure (2.1) Conceptual Framework for the Expenditure on the Satisfaction Factors



Source: Own Compilation (2023)

CHAPTER III

RESEARCH METHODOLOGY

In this chapter, the research methods for sample selection and data collection are discussed. The section provided with the insight into questionnaire design, variables and techniques. And presented the multivariate techniques such as the factor analysis and the multiple regression analysis.

3.1 Survey Design

The farmers who were purchased from Integrated Swanyee Social Business (ISSB) Company are considered as the study population. In the selection of the sample, a two-stage random sampling method was used.

In the first stage, 32 villages were selected from 100 villages in 5 townships (Aung Lan, Tha Yet, Kan Ma, Magway, Taung Dwin Gyi) in Magway Division by using simple random sampling.

In the second stage, 298 farmers were selected from 920 farmers who use vermi-fertilizer in 32 villages selected at the first stage by using simple random sampling.

3.2 Determination of Sample Size

The following formula was used for sample size determination.

$$n = \frac{NZ^2_{\alpha/2}\, p(1-p)}{(N-1)d^2 + Z^2_{\alpha/2}\, p(1-p)} \qquad (3.1)$$

N = Population size = 920

P = Expected proportion (Percentage of success 50%) = 0.5

$\propto$ = Significance level = 5%

$Z_{\propto/2}$ = Z statistic for a level of confidence = Standard normal value for 5% sig. level

d = Precision (margin of error) = 0.05

n = Sample size with finite population correction

$$n = \frac{920 \text{ x } 1.96^2 \text{ x } (0.5)\ (0.5)}{(919)\ (0.05)^2 + 1.96^2\ (0.5)\ (0.5)}$$

$$n = \frac{883.57}{3.26}$$

$$n = 271$$

According to the sample size formula, the required sample size is determined 271 farmers as least number, but it was considered to 10% of non-respondents and other risks. Therefore 298 participants took part in this study, which was sufficient in order to start analysis. Table (3.1) shows sample size allocation.

Table (3.1) Sample Size Allocation

Townships	Target villages	Sample villages	Target Populations	Sample Populations
Aung Lan	31	10	238	77
Kan Ma	24	8	279	90
Taung Twin Gyi	10	3	107	35
Magway	6	2	63	21
Tha Yat	29	9	233	75
Total	100	32	920	298

Source: Survey Data (2019)

3.3 Questionnaire Design

Questionnaire contained 29 questions. Questionnaire begins with short introduction in order to explain the purpose of the study and what is expected from the participants. Question number 1 to 9 of the survey are about respondent's demographic characteristic. Question number 10 and 11 of the survey are about farmer economic characteristic. The attributes are annual incomes and annual expenditures of families. Question number 12 to 27 of the survey are about crops and fertilizer and utilization of fertilizer.

Question number 28 is about the advantages of using bio fertilizer. Respondents were asked to indicate the level of agreement for each scale item. Five points Likert scale was used for this question with following categories “strongly disagree”, “disagree”, “neutral”, “agree” and “strongly agree”.

3.4 Factor Analysis

Factor analysis has provoked rather turbulent controversy throughout its history. Its modern beginnings lie in the early 20th century attempts of Korl Pearson, Charles Spearman, and others to define and measure intelligence. Intuitively, factor analysis is a data reduction technique used to reduce a large number of variables to a smaller set of underlying factors that summarize the essential information contained in the variables. More frequently factor analysis is used as an exploratory technique when the researcher wishes to summarize the structure of a set of variables.

The essential purpose of factor analysis is to describe, if possible, the covariance relationships among many variables in term of a few underlying, but unobservable, random quantities called factors. Basically, the factor model is motivated by the following argument. Suppose variables can be grouped by their correlations. That is, suppose all variables within a particular group are highly correlated among themselves, but have relatively small correlations with variables in a different group. Then it is possible that each group of variables represents a single underlying construct or factor, that is responsible for the observed correlation. Factor analysis can be considered and extension of principle component analysis. Both can be viewed as attempts to approximate the covariance matrix $\sum$. However, the approximation based on the factor analysis model is more elaborate.

3.4.1 Testing of Sampling Adequacy of the Approach

Kasier – Meyer-Olkin (KMO) and Bartlett’s Test of Sphericity is a measure of sampling adequacy that it is recommended to check the case for variable ratio for the analysis being conducted. In most academic and business studies, KMO and Bartlett’ test play an important role for accepting the sample adequacy.

The Bartlett's Test of Sphericity relates to the significance of the study and thereby shows the validity and suitability of the responses collected to the problem being addressed through the study. For a large sample, Bartlett's test approximates a chi-square distribution. However, the Bartlett's test compares the observed correlation matrix to the identity matrix. This test the null hypothesis that the correlation matrix is an identity matrix. For principal component analysis to be recommended suitable, the significant level of the Bartlett's Test of Sphericity must be less than 0.05. In addition to, very small values of significance (below 0.05) indicate a high probability that there are significant relationships between the variables, whereas higher values (0.1 or above) indicate the data is inappropriate for principal component analysis. The values of Kaiser-Meyer-Olkin are:

Table (3.2) Kasier – Meyer-Olkin (KMO) and Bartlett's Test

KMO Value	Degree of Common Variance
KMO > 0.9	Marvelous
0.80 < KMO < 0.90	Meritorious
0.70 < KMO < 0.80	Middling
0.60 < KMO < 0.70	Mediocre
0.50 < KMO < 0.60	Miserable
KMO < 0.50	Unacceptable

Source: Henry Kaiser (1970)

3.4.2 Reliability Analysis

Reliability is the scale construction counterpart of precision and accuracy in physical measurement. Reliability can be thought of as consistency in measurement. To establish the reliability of the farmers' satisfaction measurement used in the survey instrument, the reliability coefficient (Cronbach Alpha) was verified. There are a number of different reliability coefficients. One of the most commonly used is Cronbach's alpha, which is based on the average correlation of items within a test if the items are standardized. If the items are not standardized, it is based on the average covariance among the items. Because Cronbach's alpha can be interpreted as a correlation coefficient, it ranges in value from 0 to 1. Robinson and Shaver (1973) suggested that if Alpha is greater than 0.7, it means high reliability and if Alpha is

smaller than 0.3, it means low reliability. Moreover, it is often said that the higher the Cronbach's Alpha is, the more reliability scale has.

3.5 Regression Analysis

Regression analysis is concerned with the study of the dependence of one variable, the dependent variable, on one or more other variables, the explanatory variables, with a view to estimating and/or predicting the (population) mean or average value of the former in terms of the known or fixed (in repeated sampling) values of the latter.

3.5.1 Simple Linear Regression Model

The simple regression model can be used to study the relationship between two variables. The simple regression model has limitation as general tool for empirical analysis. Nevertheless, it is sometime appropriate as an empirical tool.

Much of applied econometric analysis begins with the following premise: Y and X are two variables, representation some population, and interested in "explaining terms of X", or in "studying how Y varies with changes in X". In writing down a model that will "explain Y in terms of X", are following.

$$Y=\beta_0 + \beta_1 X + \varepsilon \qquad (3.2)$$

where Y= dependent variable (or) explained variable

X=independent variable (or) explanatory variable

β0=regression constant (or) intercept

β1=regression coefficient (or) slope

ε = random error term (or) residual

Equation (3.2), which is assumed to hold in the population of interest, defines the simple linear regression model. It is also called the two-variable linear regression model or bivariate linear egression model because it relates the two variable X and Y.

When related by Equation (3.2), the variables Y and X have several different names used interchangeably, as follows; Y is called the dependent variable, the explained variable, the responses variable, the predicted variable, or the regressed. X is called the independent variable, the explanatory variable, the control variable, the predictor variable, or the repressor. The variable ε, called the error term or disturbance

in the relationship, represents factors other than X that affect Y. A simple regression analysis effectively treats all factors affecting Y other than X as being unobserved.

Thus the change in Y is simply β_1 multiplied by the change in X. This means that β_1 is the slope parameter in the relationship between Y and X holding the other factors in ε fixed: it is of primary interest in applied economics. The intercept parameter β_0 also has its uses, although it is rarely central to an analysis. The linearity of Equation (3.2) implies that a one-unit change in X has the same effect on Y regardless of the initial value of X.

3.5.2 Ordinary Lease Square Estimates (OLS)

The dominate and powerful estimating principle, which emerged in the early years of the nineteenth century for this and other problems, is that of least squares. Let the residuals from any fitted straight line be denoted by

$\varepsilon_i = Y_i - Y_t = Y_i - \beta_0 - \beta_1 X_i \quad ; \quad i = 1,2,\ldots,n$ (3.3)

The residual sum of square is thus a function of β_0 and β_1. The lease squares principle is

RSS = $\sum \varepsilon_i^2$

The necessary conditions for a stationary value of RSS are

$$\frac{\partial(\Sigma\varepsilon_i^2)}{\partial\beta_0} = -2\Sigma(Y_i - \beta_0 - \beta_1 X_i) = -2\Sigma\varepsilon = 0$$

And $$\frac{\partial(\Sigma\varepsilon_i^2)}{\partial\beta_1} = -2\Sigma X(Y_i - \beta_0 - \beta_1 X_i) = -2\Sigma X\varepsilon = 0$$

Simplifying gives the normal educations for the linear regression of Y on X. That is

$\sum Y = n\,\beta_0 + \beta_1 \sum X$

$\sum XY = \beta_0 \sum X + \beta_1 \sum X^2$

The reason for the adjective normal will become clear when we discuss the geometry of least squares later. The first normal education may be rewritten as

$\beta_0 = \bar{Y} - \beta_1 \bar{X}$ (3.4)

Substituting β_0 in the second normal education gives

$$\beta_1 = \frac{\Sigma XY}{\Sigma X^2} = \gamma \frac{s_Y}{s_X} \quad (3.5)$$

Thus the least square of slope may first of all be estimated by Equation (3.5) from the sample deviations, and the intercept then obtained from substituting for β_1 in Equation (3.4). The intercept and slope of the conditional mean in the bivariate normal distribution. The only deference is that Equation (3.4) and Equation (3.5) are in terms of sample statistics.

To summarize, the least square line has three important properties. It minimizes the sum of squared residuals. It passes through the mean Point ($\bar{X}$,$\bar{Y}$), as shown by Equation (3.4). Finally, the least-square residuals have zero correlation in the sample with the value of X.

3.5.3 Assumptions Underlying the Simple Regression Model

The assumption made on the population regression equation and on the error term in particular is important for the properties of the estimated parameters. It is therefore important to have a sound understanding of what the assumptions are the why they are important. Thus, assumption about the X variables and the error term are extremely critical to the valid interpretation of the regression estimate. Unless these assumptions, there is no way to make any statistical inference from proposed regression model.

The Gaussian, standard, or classical linear regression model (CLRM), which is the cornerstone of most econometric theory, makes 9 assumptions. We first discuss these assumptions in the context of the two-variable regression model; and we extend them to multiple regression models, that is, models in which there is more than one repressor.

Assumption 1: Linear regression model. The regression model is linear in the parameters, as shown in

$Y_i = \beta_1 + \beta_2 X_i + \varepsilon_i$

Assumption 2 : X value are fixed in repeated sampling. Values taken by the regressor X are considered fixed in repeated samples. More technically, X is assumed to to be no stochastic.

Assumption 3 : Zero mean value of disturbance ε_t. Given the value of X, the mean, or expected, value of the random disturbance term ε_i is zero. Technically, the conditional mean value of ε_i is zero. Symbolically, we have

$E(\varepsilon_i \backslash X_i)$ (3.6)

The distances above and below the mean values are nothing but the ε_i , and what (3.6) requires is that the average or mean value of these deviations corresponding to any given X should be zero.

Assumption 4 : Homoscedasticity or equal variance of ε_i is the same for all observations. That is , the conditional variances of are identical. Symbolically, we have

$$\begin{aligned} Var(\varepsilon_i \backslash X_i) &= E[\varepsilon_i - E(\varepsilon_i \backslash X_i)]^2 \\ &= E(\varepsilon_i^2 \backslash X_i) \\ &= \sigma^2 \end{aligned}$$

Assumption 5 : No autocorrelation between the disturbances. Given any two X values, $X_i$and X_j ($i \neq$ j), the correlation between any two ε_i and ε_j ($i \neq$ j) is zero. Symbolically,

$$\begin{aligned} cov\,(\varepsilon_i, \varepsilon_j \backslash X_i, X_j &= E\{[\varepsilon_i - E(\varepsilon_i)]\}\{[\varepsilon_i - E(\varepsilon_j)]\backslash X_j\} \\ &= E(\varepsilon_i \backslash X_i)(\varepsilon_j \backslash X_j) \\ &= 0 \end{aligned}$$

where i and j are two different observations and where cov means covariance.

Assumption 6 : Zero covariance between $(\varepsilon_i \; and \; X_i)$, or $E(\varepsilon_i \backslash X_i) = 0$

Assumption 7 : The number of observations n must be greater than the number of parameter to be estimated. Alternatively, the number of observations n must be greater than the number of explanatory variables.

Assumption 8 : Variability in X values. The X value in a given sample must not all be the same. Technically, var(X) must be a finite positively number.

Assumption 9 : The regression model is correctly specific. Alternatively, there is no specification bias or error in the model used in empirical analysis. The model used to test an economic theory is “correctly specified”.

These assumptions form the basis for the regression analysis. It is upon them that the foundation of OLS is built. A complete comprehension of regression analysis in not possible without an understanding of these assumptions.

3.5.4 Multiple Linear Regression Model

Multiple linear regression analysis is one of the most widely used statistical techniques which is regarded as the “Mother of All Statistical Techniques”. There are several independent variables and one dependent variable in the multiple regression model. It can be used to analyze data from causal-comparative, which is a research design that seeks to find relationship between independent and dependent and dependent variables after and action or event has already occurred, correlational. Or experimental research. It can handle interval, ordinal, or categorical data. Moreover, multiple regression analysis provides estimates both of the magnitude and statistical significance of relationships between variables. Multiple regression analysis can also handle as many independent variables as is called for by theory at least as long as there is an adequate sample size. However, it is limited to one dependent, or explained variable. Most business situations are complex enough that using more than one independent variable impact the dependent variable or production a forecast of the future behavior of the dependent variable.

The multiple linear regression models are an extension of a simple linear regression model to incorporate two or more independent variables in a prediction equation for a response variable. The use of two or more independent variables regression analysis is an extension of the basic principle used in two-variable regression analysis. It is necessary to determine the equation for the average relationship between the variables.

The multiple regression model with k independent variable is

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \cdots + \beta_k X_{ij} + \varepsilon_i \quad ; \quad i = 1,2,\dots,p \tag{3.7}$$

where, Y_i= Dependent variable

β_0= Constant (coefficient of intercept)

$X_{i1}, \dots, X_{ij}$= Independent variables

$\beta_1, \dots, \beta_k$ = Regression coefficients of independent variables

ε_i = Residual term

A multiple regression correlation can also be computed to determine if a significant relationship exists between the independent variables and dependent variable. In the multiple regression analysis, the strength of the relationship between

the independent variables and dependent variable is measured by a correlation coefficient. This multiple correlation coefficient is symbolized by R. Then R^2 is the coefficient of multiple determination, and it is the amount of variation explained by the regression model. The expression 1- R^2 represents the amount of unexplained variation. Since the values of R^2 is dependent on n (the number of data pairs) and k (the number of variables), statisticians also calculate what is called an adjusted R^2, denoted by R^2_{adj}. This is based on the number of degrees of freedom. Both R^2 and R^2_{adj} are usually reported in a multiple regression analysis.

3.5.5 Assumptions of the Multiple Linear Regression Model

The following are the necessary assumptions underlying the multiple linear regression models when inference is an objective of the analysis:

1. The X_i may be either random or non-random (fixed) variables. Because of their role in explaining the variability in the dependent variable Y, they are sometimes referred to as explanatory variables. The X_i is also sometime referred to as predictor variables, because of their role in predicting.
2. The independent variables, the X_i values, are measured without error.
3. For each combination of X_i values, there is a normally distributed subpopulation of Y values.
4. The variances of the subpopulations of Y values are all equal.
5. The X values are independent. This means that the value observed for one value of X does not depend on the value observed for another value of X.
6. The ε_i is normally and independently distributed with mean 0 and variance σ^2.
7. There is no multicollinearity. That is, there are no perfect linear relationships among the explanatory variables.

3.5.6 Multicollinearity

One of the assumptions of Classical Linear Regression Model (CLRM) is that there is no multicollinearity among the repressors included in the regression model. The multicollinearity problem occurs when two or more explanatory variables are highly correlated.

According to Ragnar Frisch, the term multicollinearity meant by the existence of a perfect or exact, linear relationship among some or all explanatory variables of a regression model. Therefore, the multicollinearity problem occurs when two or more explanatory variables are highly correlated. The most direct way of testing for multicollinearity is to produce a correlation matrix for all variables in the model. If a correlation is greater than 0.7, the independent variables are highly correlated. If a correlation is less than 0.5, it can be concluded that multicollinearity is not problem. Another way to detect multicollinearity is to use the value of tolerance.

If the value of Tolerance is not less than 0.1 , it can be said that there is no multicollinearity problem in this study. The third way to detect multicollinearity is to use the variance inflation factor (VIF). The VIF for any way independent variable is a measure of the degree of the multicollinearity contributed by that variable.

The VIF for any given independent variable is

$$VIF = \frac{1}{1-R^2} \tag{3.8}$$

where, R^2 = coefficient of determination

Multicollinearity produces and increase in the variation, or standard errors, of the regression coefficient. In general, multicollinearity is not considered a significant problem unless the VIF of a single independent variable measure at least 10 or the sum of VIF's for all independent variables is at least 10. There are two types of multicollinearity: namely; "perfect" multicollinearity and "imperfect" multicollinearity.

CHAPTER IV

ANALYSIS OF FACTOR AND MULTIPLE REGRESSION FOR FARMERS' SATISFACTION AND EXPENDITURE

In this chapter, the results of the study and analysis are collected from the primary data. Factor Analysis, Multiple Regression Analysis are applied for analyzing survey data. The data for this study is collected from personal interviews based on a survey questionnaire. The first part presents the respondent's profile and the respondent's used fertilizer and planted information. On the other hand, the second part includes the respondent's satisfactions on the advantages of using bio fertilizer such as quality of crops, price, environment, services and safety and friendly use. The last part explores the relationship between expenditure and their satisfaction on the vermi-fertilizers.

4.1 Profiles of the Respondents

Descriptive statistics methods are used to analyze the collected data, to summarize and describe to respondents' profile. There are three parts in the respondents' profile, the first part shows the demographic characteristics of the respondents, the second part shows household members, annual income and expenditure of the respondents and the third parts describes the use of crops and fertilizers.

4.1.1 Demographic Characteristics of the Respondents

The demographic characteristics including gender, race, religion, age and no of household members of the respondents are shown in this section. In Table (4.1) and Figure (4.1), in classification of the number of respondents, 63 % of the respondents are male and 37 % of respondents are female. The different percentage is 26% between male and female respondents.

Table (4.1) Gender of the Respondents

Gender	Number of Respondents	Percent
Male	188	63
Female	110	37
Total	298	100

Source: Survey Data (2019)

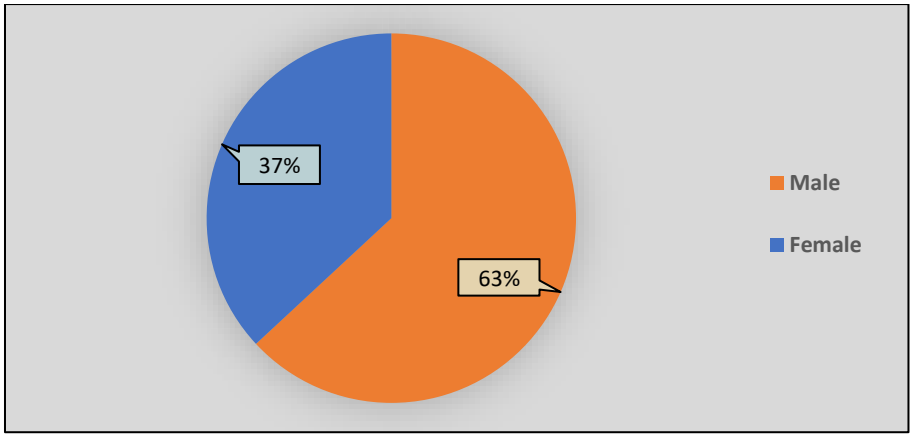


Figure (4.1) Gender of the Respondents

Source: Table (4.1)

All of the respondents 100% are Burmese shown in Table (4.2).

Table (4.2) Race of the Respondents

Race	Number of Respondents	Percent
Burmese	298	100

Source: Survey Data (2019)

According to the Table (4.3), religion of the respondents, all 100% of the respondents are Buddhist.

Table (4.3) Religion of the Respondents

Religion	Number of Respondents	Percent
Buddhist	298	100

Source: Survey Data (2019)

Table (4.4) Age of the Respondents

Age Group (Year)	Number of Respondents	Percent
≤ 20	2	0.7
21-40	116	38.9
41-60	149	50
>60	31	10.4
Total	298	100

Source: Survey Data (2019)

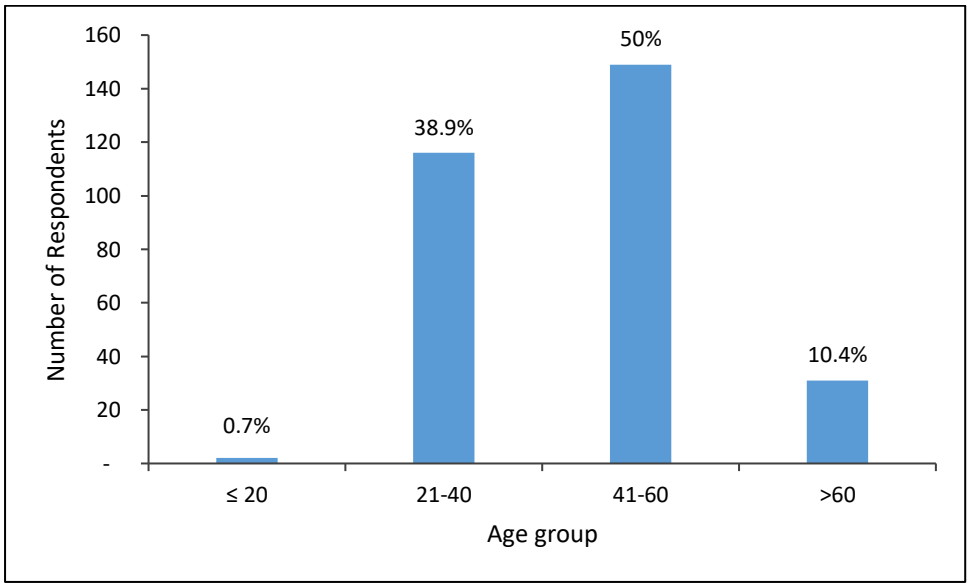


Figure (4.2) Age of the Respondents

Source: Table (4.4)

In Table (4.4) and Figure (4.2), the majorities 50% of the respondents are 41-60 years old, those aged 21-40 make up 38.9%, while 10.4% of the respondents are over 60 years old and 0.7% of respondents are 20 or less than 20 years old.

With regard to the age of the respondents, the minimum age of the respondents is 18 years and maximum age of the respondents is 73 years. The average age of the respondents is 45 years and standard deviation is 11 years.

Table (4.5) Household Member of the Respondents

Age Group (Year)	Number of Respondents	Percent
2-4	169	56.7
5-7	122	40.9
8-10	7	2.4
Total	298	100

Source: Survey Data (2019)

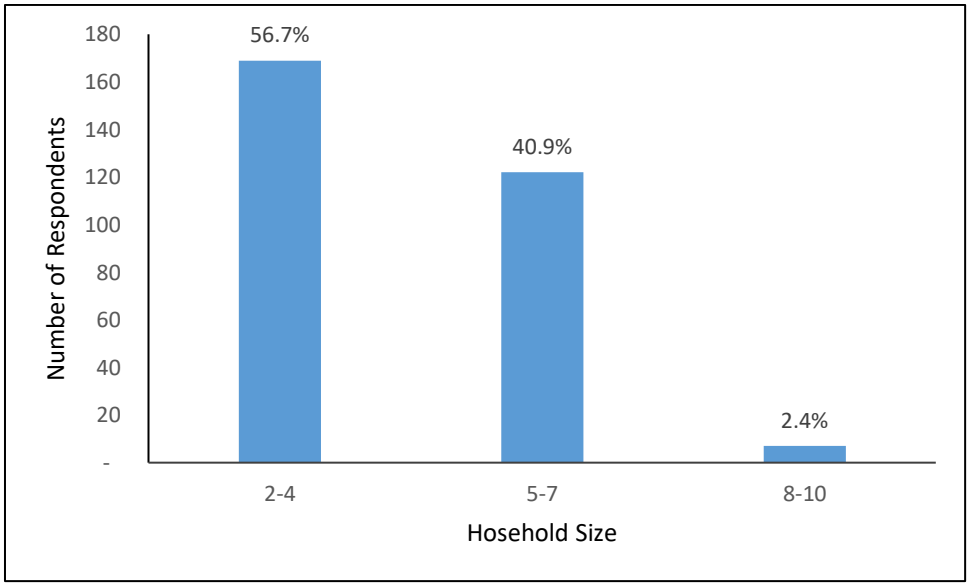


Figure (4.3) Household Members of the Respondents

Source: Table (4.5)

The household size of the respondents is shown in Table (4.5) and Figure (4.3). 56.7% of the respondents' family has 2-4 members in each household, 40.9% of the respondents' family has 5-7 members and 2.4% of the respondents' family has 8-10 members.

In classification of the number of household members, minimum household members are 2 persons and maximum are 10 persons. The average household member is 4.44 persons and standard deviation is 1.35 person.

4.1.2 Socio-Economic Characteristics of the Respondents

Table (4.6) and Figure (4.4) shows the level of education, almost 60% of the respondents are Primary level, 25 % are secondary level, 11% are high school level, and 0.5% are illiterates and 0.5%other. 1% are under graduates and 2% are graduates.

Table (4.6) Education of the Respondents

Education	Number of Respondents	Percent
Illiterate/No education	2	0.7
Monastic education, literate/Primary level	179	60.1
Secondary level	74	24.8
High school	32	10.7
Under Graduate	4	1.3
Graduate	5	1.7
Other	2	0.7
Total	298	100

Source: Survey Data (2019)

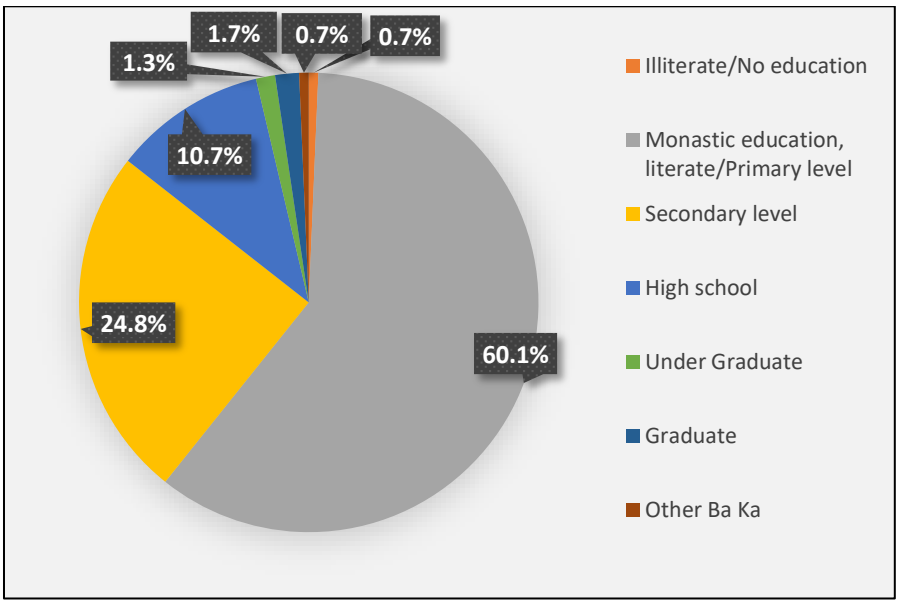


Figure (4.4) Education of the Respondents

Source: Table (4.6)

According to the Table (4.7) and Figure (4.5), occupation of the respondents, almost all of the respondents 96% are dealing with only farming. And the rest few percentages 4.03% of the respondents are dealing with both for farming and other jobs such as hair dressing, livestock, trading, driving, serving as government staff, and serving as daily workers and so on.

Table (4.7) Occupation of the Respondents

Occupation	Number of Respondents	Percent
Farmer	286	96
Farmer/Hair Dresser	1	0.3
Farmer/Live Stock	3	1
Farmer/Trade	3	1
Farmer/Driver	1	0.3
Farmer/Dependent	1	0.3
Farmer/staffs	1	0.3
Farmer/Teacher	1	0.3
Farmer/Daily Worker	1	0.3
Total	298	100

Source: Survey Data (2019)

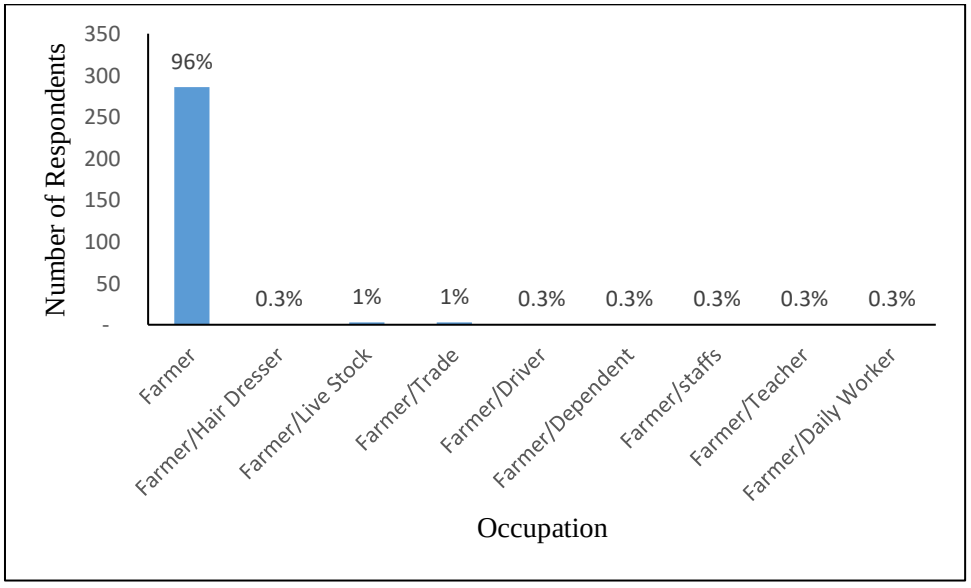


Figure (4.5) Occupation of the Respondents

Source: Table (4.7)

Table (4.8) Annual Income of the Respondents

Annual Income (Kyats in Lakh)	Number of Respondents	Percent
≤ 10	32	10.7
Nov-20	94	31.6
21-30	60	20.1
31-40	42	14.1
41-50	42	14.1
>50	28	9.4
Total	298	100

Source: Survey Data (2019)

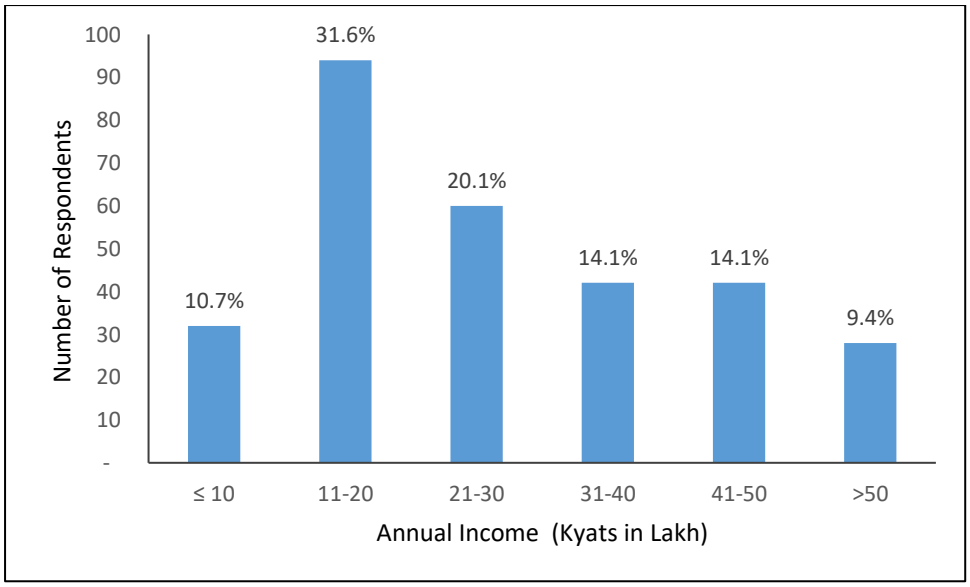


Figure (4.6) Annual Income of the Respondents

Source: Table (4.8)

In Table (4.8) and Figure (4.6), with regard to the respondents' annual household income, the largest group included those with and annual household income of MMK 1,100,000 to MMK 2,000,000 (31.6%), followed by MMK 2,100,000 to MMK 3,000,000 (20.1%), MMK 1,000,000 or below (10.7%), MMK 3,100,000 to MMK 4,000,000 (14.1%) and MMK 4,100,000 to MMK 5,000,000 (14.1%). Only 9.4% of the respondents had and annual household income of MMK above 5,000,000.

In classification of the annual total household income, the minimum annual household income is MMK 300,000 and maximum annual household income is MMK

30,000,000. The average annual household income is MMK 3,198,660 and standard deviation is MMK 2,557,920

According to the annual total household expenditure, the minimum annual household expenditure is MMK 100,000 and maximum annual household expenditure is MMK12,000,000. The average annual household expenditure is MMK 2,208,690 and standard deviation is MMK 1,670,340.

4.1.3 Plantation of Crops

The information for the crops collected from the respondents are described in table (4.9). The respondents use vermi-fertilizers by 25.30 percent to grow plant bean, 19.73 percent of respondents use for paddy plantation, 16.53 percent of respondents use for sesame, 12.19 percent of respondents use to plant for onion, 8.37 percent of respondents to deal with cotton, 8.16 percent of respondents to grow for vegetable, 5.57 percent of the respondents use for planting chili, 2.38 percent of respondents for corn plantation, 0.93 percent of respondents for tomato plants, 0.21 percent of respondents use to grow in sugarcane plants, 0.21percent of respondents use to operate in flower plants, 0.21 percent of respondents apply for betel plantation, and 0.21percent of respondents use for the purpose of tobacco plants.

The respondents are dealing with farming for selling by using 43.73 percent of vermi-fertilizers, and 0.64 percent of respondents are growing the above mentioned to consume while 55.63 percent of respondents are planting both for selling and providing their needs for consumption.

The respondent's 95.77 percent sell through agencies/broker house, and 4.23 percent of respondents sell directly to markets.

The respondents get crop information by 64.51 percent through their networks, 15.27 percent of respondent got information of crops through television, 13.10 percent of respondent got information for crops from radio broadcasting, 5.44 percent of respondent got information for crops on internet, 1.69 percent of respondent got information of sources of crops from journals/newspapers.

Table (4.9) Types of Crops and Information Sources of Crops

Variable	Frequency	Percent
Type of crops		
Paddy	191	19.73%
Bean	245	25.30%
Sesame	160	16.53%
Onion	118	12.19%
Chilli	54	5.57%
Cotton	81	8.37%
Vagatable	79	8.16%
Corn	23	2.38%
Sugar cain	2	0.21%
Tomato	9	0.93%
Flower	2	0.21%
Betel	2	0.21%
Tobacco	2	0.21%
Purpose		
to sale	136	43.73%
to consume	2	0.64%
both (to sale, to consume)	173	55.63%
Customers		
Through agencies/Broker house	294	95.77%
Direct	13	4.23%
Inforamtion sources for crops		
Journal/Newspaper	7	1.69%
Television	62	15.27%
Radio	53	13.10%
Internet	22	5.44%
Friends	262	64.51%

Source: Survey Data (2019)

4.1.4 Utilization of Fertilizers

The information for the fertilizers collected from the respondents are described in table (4.10). 79.37 percent of the respondents are raised awareness through marketing staff for the information of vermi-fertilizers. 17.78 percent of the respondents are known from the other peoples and 2.54 percent of respondent are known through bill boards, and 0.32 percent of respondents are through on air.

Chemical fertilizers are being used by 72.27 percent of respondents before they use vermi-fertilizers and 27.73 percent of respondents used natural fertilizers before they use the vermi-fertilizers.

The respondents use vermi-fertilizers by 48.92 percent exclusively while 51.08 percent of the respondents mixed with chemical fertilizers.

The respondents purchased 95.65 percent of the vermi-fertilizers from village agents, 3.68% of the respondents purchase from township agents and 0.67 percent of the respondents purchase from shop.

Table (4.10) Using Vermi-Fertilizer of Respondents

Variable	Frequency	Percent
Vermi liquid and vermi compost information from		
Awareness	250	79.37%
other people	56	17.78%
Radio	1	0.32%
Bill Board	8	2.54%
Fertilizers before using vermi fertilizer		
Natural Fertilizer	104	27.73%
Chemical Fertilizer	271	72.27%
Using vermi with another things		
vermi Fertilizer exclusively	158	48.92%
Mixing with other fertilizers	165	51.08%
Purchase from		
Shop	2	.67%
Village Agent	286	95.65%
Township Agent	11	3.68%

Source: Survey Data (2019)

As shown in the Table (4.11), minimum land acre owned by respondents is 0 acre why is that the respondents lease land for planting and maximum land acre owned by respondents are 50 acres. The average land acre owned by respondents are 6.47 acres and standard deviation is 5.64 acres.

Minimum land acre used with vermi-fertilizers by respondents is 0 acre why is that is the respondents lease land for planting and maximum land acre used with vermi-fertilizers by respondents are 12 acres. The average land acre used with vermi-fertilizers are 2.18 acres and standard deviation is 1.60 acres.

Minimum land acre used exclusively vermi-fertilizers by respondents is 0 acre why is that is the respondents lease land for planting and maximum land acre used with vermi-fertilizers is 12 acres. The average land acre used with vermi-fertilizers is 0.86 acres and standard deviation is 1.3 acres.

Minimum times in planting in a year by respondents are 1 time and maximum planting times in a year by respondents are 3 times. The average planting times in a year by respondents are 2.17 times and standard deviation is 0.49 time.

Table (4.11) Average, Standard Deviation, Minimum and Maximum of the Respondents' Planted Land Area

Household Profile	Minimum	Maximum	Average	Std. Deviation
Own land acre (n=298)	0	50	6.47	5.64
Land acre being used Swanyee vermi-liquid and compost (n=298)	0	12	2.18	1.60
Land acre being used exclusively Swanyee vermi-liquid and compost (n=298)	0	12	0.86	1.3
Planting time in a year (n=298)	1	3	2.17	0.49

Source: Survey Data (2019)

Table (4.12) reports the results of summary statistics of the respondents' used on vermi-fertilizers. Maximum used of vermi-liquid for one acre by respondents is 22 liters. The average used of vermi-liquid for one acre by respondents is 6.08 liters and standard deviation is 1.85 liters.

Maximum used of vermi compost for one acre by respondents is 100 kilograms. The average used of vermi compost for one acre by respondents is 24.28 kilograms and standard deviation is 25.62 kilograms.

Maximum used of vermi liquid for one season by respondents is 72 liters. The average used of vermi liquid for one season by respondents is 12.86 liters and standard deviation is 9.37 liters.

Maximum used vermi compost for one season by respondents is 750 kilograms. The average used of vermi compost for one season by respondents is 34.8 kilograms and standard deviation is 60.83 kilograms.

Maximum used of vermi liquid for one year by respondents is 132 liters. The average used of vermi liquid for one year by respondents is 17.71 liters and standard deviation is 16.79 liters.

Maximum used of vermi compost for one year by respondents is 750 kilograms. The average used of vermi compost for one year by respondents is 40.32 kilograms and standard deviation is 72.31 kilograms.

Table (4.12) Average, Standard Deviation and Maximum of the Respondents' Used on Vermi-fertilizers

Household Profile	Maximum	Average	Std. Deviation
Used vermi liquid for one acre (liter) (n=298)	22	6.08	1.85
Used vermi compost for one acre (kg) (n=298)	100	24.28	25.62
Used vermi liquid for one season (liter) (n=298)	72	12.86	9.37
Used vermi compost for one season (kg) (n=298)	750	34.8	60.83
Used vermi liquid for one year (liter) (n=298)	132	17.71	16.79
Used vermi compost for one year (kg) (n=298)	750	40.32	72.31

Source: Survey Data (2019)

Table (4.13) reports the results of summary statistics of the expenditure on vermi-fertilizer. Minimum spend of vermi liquid and vermi compost for one acre by respondents is MMK 5000 and maximum spend vermi liquid and vermi compost for one acre by respondents is MMK 90,000. The average spending of vermi liquid and vermi compost for one acre by respondents is MMK 30,000 and standard deviation is MMK16,470.

Minimum spending of vermi-liquid and vermi-compost for one season by respondents is MMK 5000 and maximum usage of vermi-liquid and vermi-compost for one season by respondents is MMK 547,500. The average spending level of

vermi-liquid and vermi-compost for one season by respondents is MMK 53,650 and standard deviation is MMK 47,760.

Minimum spending of vermi-liquid and vermi-compost for one year by respondents is MMK 5000 and maximum spending of vermi-liquid and vermi-compost for one year by respondents is MMK 645,000. The average spending level of vermi-liquid and vermi-compost for one year by respondents is MMK 69,440 and standard deviation is MMK 70,280.

Table (4.13) Average, Standard Deviation, Minimum and Maximum of the Expenditure on Vermi-fertilizers

Household Profile	Minimum	Maximum	Average	Std. Deviation
Spend on one acre (kyat '000) (n=298)	5	90	30	16.47
Spend on one season(kyat '000) (n=298)	5	547.5	53.65	47.76
Spend on one year (kyat '000) (n=298)	5	645	69.44	70.28

4.2 Factor Analysis for Farmers' Satisfaction

According to the Appendix (3), factor analysis is conducted to create correlated variable composites from the 23 attributes and to identify a smaller set of dimensions, of factors. The principal component method is used to generate the initial solution. The factors with eigenvalues greater than or equal to 1.0 and attributes with factor loadings greater than 0.3 are reported. From the varimax-rotated factor matrix, five factors with 22 variables (Production rate gets better, The Production rate is not decreased, Improved seeds quality, Improved product quality, Good color quality of Crops, Long storage life, Fair price, Matching the price with quality, Safe for consumers, Easy to use, Provide improving soil quality, Make soil quality for long term use, Recover soil degradation, By using long-term prevent danger of insect, Protect environmental, Make air to be fresh, By using long-term reduce soil degradation, Good payment system, Products arrive in the right time, Convenient transportation, Good communication between sellers and users, Good dealing with

issues). The eigenvalues suggested that a five common factor solution explained 66.387% of the overall variance.

The overall significance of the correlation matrix is 0.000, significance value lower than 0.01, with a Bartlett Test of Sphericity value of 4118.903. Since the Bartlett test of Sphericity is significant and the Kaiser-Meyer-Olkin) KMO Measure of Sampling Adequacy is 0.873, it greater than 0.5 which is meritorious, factor analysis is suitable to analyze the survey data. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett Test of Sphericity are given in Table (4.14).

Table (4.14) Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.873
Bartlett's Test of Sphericity	Approx. Chi-Square	4118.903
	df	253
	Sig.	0.000

Source: SPSS Output

Cronbach's alpha interpreted that correlation coefficient it ranges in value from 0 to 1. And Alpha is greater than 0.7, it means high reliability. That is meritorious, factor analysis is suitable to analyze the survey data. The Reliability are given in Table (4.15).

Table (4.15) Reliability

Cronbach's alpha	0.900
No. of Items	23

Source: SPSS Output

The Figure (4.7) represents an elbow occurs in the scree plot at about i=7.5. That is, the eigenvalues after $\hat{\lambda}_5$ are all relatively small and about the same size. In this case, it appears, without any other evidence, that five common factors effectively summarize the total sample variance.

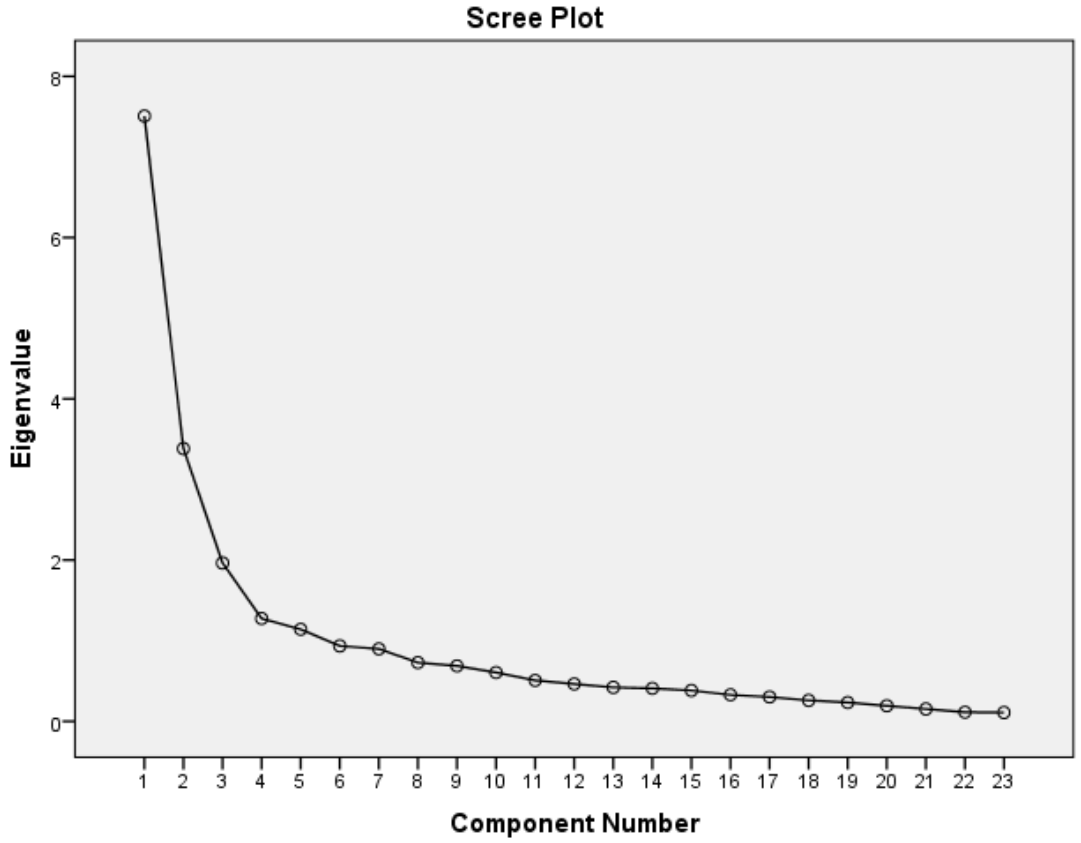


Figure (4 .7) Scree Plot

Source : SPSS Output

Appendix (3) illustrates the results of the factor analysis, by using factor analysis, 22 variables are reduced to five common factors from original variables. Therefore, these selected five factors are renamed or labelled by representing variables concerned. At the initial stage, it shows the factors and their associated eigenvalues, the percentage of variance explained and the cumulative percentages. With reference to the eigenvalues, the selectors are extracted, then 66.387 % of the variance would be explained. The selected five factors are Environment, Service, Quality of Crops, Price, Safety and friendly use. The selected five factors underlying the advantage of vermi-fertilizers are as follows.

Environment (Factor1) contains seven attributes and explains 32.641% of the variance in the data with an eigenvalue of 7.507. The attributes associate with this factor deal with the environment items, including Make soil quality for long term use, recover soil degradation, provide improving soil quality, protect environmental, by

using long-term, reduce soil degradation, by using long-term, prevent danger of insect, make air to be fresh.

Services (Factor2) accounts for 14.707% of the variance with an eigenvalue of 3.383. This factor is loaded with five attributes that referred to services. The five attributes are Good communication between sellers and users, Convenient transportation, Products arrive in the right time, Good payment system, Good dealing with issues.

Quality of corps (Factor 3) loads with six attributes. This factor accounts for 8.535% of the variance with an eigenvalue of 1.963. These attributes are Improved seeds quality, Improved product quality, Production rate gets better, Good color quality of Crops, Long storage life, The Production rate is not decreased.

Price factors (Factor 4) consists of two attributes. This factor accounts for 5.545% of the variance with an eigenvalue of 1.275. The two attributes are Fair price, Matching the price with quality.

Safety and friendly use (Factor 5) contain two attributes that refers to safety and friendly use on vermi-fertilizers. This factor explains 4.96% of the variance with an eigenvalue of 1.141. These attributes are Safe for consumers, Easy to use.

4.3 Multiple Regression Model

The multiple regression analysis is used to examine the relationship between farmers' expenditure on vermin fertilizer and the advantages of using vermin fertilizer. The dependent variable expenditure on vermin fertilizer is regressed against each of the factor scores of independent variables (environment, price, quality of crops, safety and friendly use, service) derived from the factor analysis. The multiple regression procedure is employed because it provides the most accurate interpretation of the independent variables. The five independent variables such as environment, price, quality of crops, safety and friendly use, service are expressed in terms of the standardized factor score (beta coefficients). The dependent variable, expenditure on vermin fertilizer is measured on a 5-point Likert-scale and is used as a substitute indicator of spending.

The multiple linear regression equation for expenditure on vermi-fertilizers can be written as

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon_i$$

Where, Y_i= Expenditure on vermi-fertilizers for one season

β_0= Constant (coefficient of intercept)

X_1= Environment

X_2= Service

X_3= Quality of Crops

X_4= Price

X_5= Safety and friendly use

X_6= Own land acres

$\beta_1, \ldots, \beta_6 =$ Regression coefficients of Factor 1 to Factor 5 and Own land acres

$\varepsilon_i =$ Residual term

4.4 Correlation Analysis

A correlation coefficient measures the strength of a linear between two variables. In this study, a correlation coefficient measures the strength of a linear between expenditure on vermi-fertilizers and the selected five factors (environment, services, quality of crops, price, safety and friendly use) and owning of land acres. The correlation between expenditure on vermin fertilizer and the Environment factor (Factor1) is positive and significant at the 0.01 level. Also owning of land acres is positive and significant at the 0.01 level. The correlation between expenditure on vermi-fertilizers and the other four factors are not significant at the 0.01 level. The correlation between expenditure on vermin fertilizer and Environment is 0.232 (p=0.000). And the correlation between expenditure on vermin fertilizer and owning of land is 0.203 (p=0.000). The correlation between expenditure on vermin fertilizer and the selected five factors and owing of land acres is shown in Table (4.16).

Table (4.16) Pearson Correlation Between Spent on Vermi-fertilizers for One Season and Selected Six Sectors

	Environment	Services	Quality of Crops	Price	Safety and friendly use	Own land Acre
Spent on vermi liquid and vermi compost for one season	0.232**	0.22	0.052	-0.004	0.004	0.203**
Sig (2-tailed)	0.000	0.704	0.368	0.941	0.944	0.000
n	298	298	298	298	298	298

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output

4.5 Results of Multiple Regression Analysis

Table (4.17) shows that the model summary of the multiple regression analysis. To predict the goodness-of-fit of the regression model, the multiple correlation coefficient (R), coefficient of determination (R^2), and F ratio are examined. Firstly, the multiple correlation coefficient (R) of independent variables (five factors, F1 to F5) on the dependent variable (Expenditure on vermi-fertilizers, or Y_i) is 0.325, which shows that the farmers had positive satisfaction with the five dimensions. Secondly, the coefficient of determination (R^2) is 0.106, suggesting that 10.6% of the variation of farmers' satisfaction is explained by the five factors.

Table (4.17) Multiple Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.325[a]	0.106	0.087	45.6236

Source: SPSS Output

In Table (4.18), the F ratio, which explains whether the results of the regression model could have occurred by chance, had a value of 5.733 (p = 0.000) and is significant at 1% level. In other words, at least one of the five factors are important in contributing to farmers' satisfaction.

Table (4.18) Analysis of Variance (ANOVA) for Multiple Regression Model

Model	Sum of Squares	Degree of freedom (d.f)	Mean Square	F	p-value
Regression	71608.516	6	11934.752	5.733	.000
Residual	605720.188	291	2081.512		
Total	677328.704	297			

Source: SPSS Output

According to the Table (4.19), Environment factor and own land acre have been found to be statistically significant at 1% level. In the estimated regression model, if all independent variables are not considered environment, services, quality of crops, price, safety and friendly use, and own land acre, the expenditure on vermi-fertilizers for one season is 41.507(‘000 kyat). The expenditure on vermi-fertilizers for one season is positively related to environment factor and own land acre. If services, quality of crops, price, safety and friendly use, and own land acre are constant, one factor score of environment increase, the expenditure on vermi-fertilizers for one season increase 11.891 (‘000 kyat).

Then, if environment, services, quality of crops, price, safety and friendly use are constant, one acre of own land acre increase, the expenditure on vermi-fertilizers for one season increase 1.878 (‘000 kyat).

From the estimated regression model, the service factor, the quality of crops factor, price factor and safety and friendly use factor have been found do not have significant on the expenditure on vermi-fertilizers for one season.

The estimated values of the coefficients for the selected five factors and own land acres have been expressed in Table (4.19).

Table (4.19) Coefficients of Factor Score for the Selected Factors

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	41.507	4.041		10.271	0.000	33.553	49.461
Environment (Factor 1)	11.891***	2.655	0.249	4.479	0.000	6.665	17.116
Services (Factor 2)	0.331	2.654	0.007	0.125	0.901	-4.892	5.554
Quality of Crops (Factor 3)	2.458	2.647	0.051	0.929	0.354	-2.752	7.669
Price (Factor 4)	-0.277	2.647	-0.006	-0.104	0.917	-5.487	4.934
Safety and Friendly Use (Factor 5)	0.838	2.652	0.018	0.316	0.752	-4.382	6.058
Own land acres	1.878***	0.473	0.222	3.972	0.000	0.947	2.808

*** Significant at 1% level

Source: SPSS Output

4.6 Testing for Normality of Disturbances

One of the basic assumptions is that disturbances are normally distributed with zero mean and constant variance. The Histogram of disturbances and the Normal plot of disturbances for the spending of vermi-fertilizers for one season are shown in Figures (4.8 and 4.9).

Figure (4.8) Histogram for Residuals of Satisfaction of Vermi-fertilizers

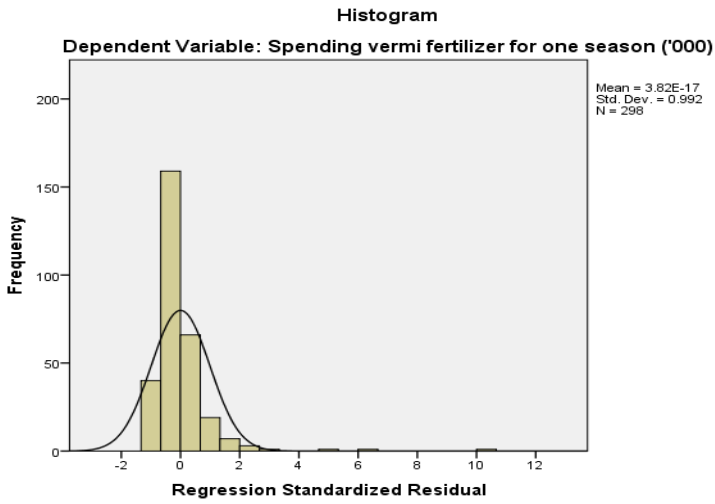
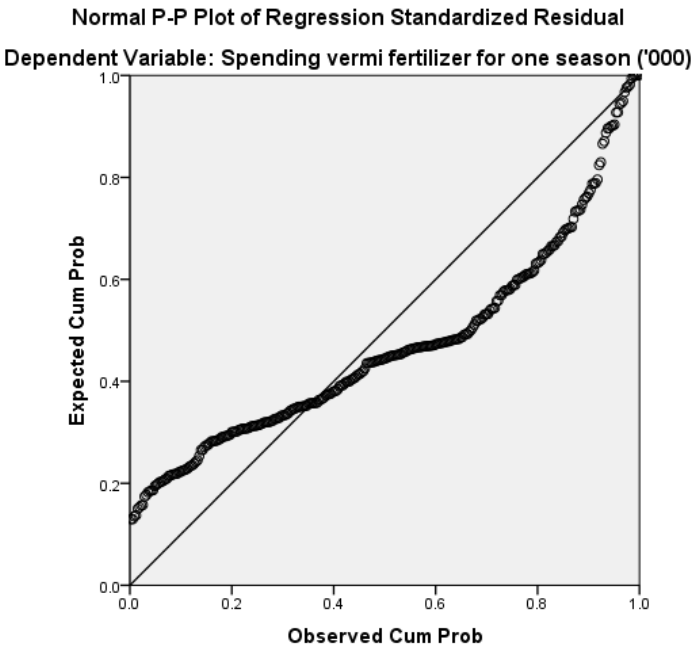


Figure (4.9) P-P Plot of Regression Residuals of Satisfaction of Vermi-fertilizers

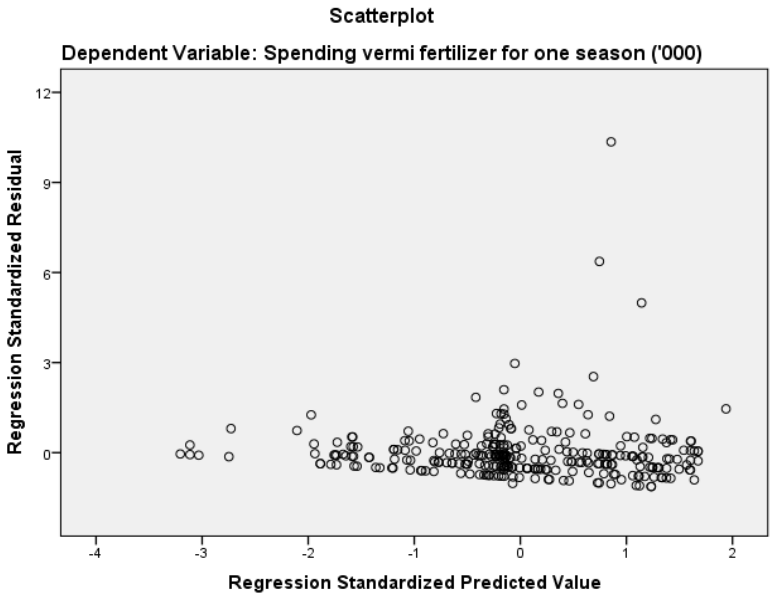


According to Figure (4.8) and Figure (4.9), Histogram, Normal P-P plot, it can be concluded that the normality assumption appears to be generally reasonable.

4.7 Testing for Homoscedasticity of Disturbances

Another basic assumption of the multiple regression model is homoscedasticity. Figure (4.10) represents the five factors on X axis and the spending on Y axis. This figure shows that homoscedasticity.

Figure (4.10) Scatterplot of Residual Against Predicted Values



4.8 Testing for Multicollinearity

In collinearity statistics, two widely used measurements, Variance Inflationary Factor (VIF) and Tolerance, are given in Table (4.20).

Table (4.20) Multicollinearity of the Selected Factors

Factors	Collinearity Statistics	
	Tolerance	VIF
Environment	0.994	1.006
Services	0.995	1.005
Quality of Crops	1.000	1.000
Price	1.000	1.000
Safty and Friently use	0.996	1.004
Own land acre	0.986	1.014

Source: SPSS Output

In this study, the value of VIF for each factor is 1, not greater than 10. Therefore, there is no a problem with multicollinearity.

CHAPTER V

CONCLUSION

The main objective of this paper is to analyze farmer's satisfaction on using vermi-fertilizers and relationship between expenditure on vermi-fertilizers and the satisfaction factors on the use of vermi-fertilizers. Using the methodology of face to face interview and examined a relationship between expenditure on vermi-fertilizers and their satisfaction. The study was based on the 298 randomly selected participants. After collecting all necessary data, factor analysis and multiple regression analysis was applied. In factor analysis, the varimax-rotated factor matrix, five factors with 22 variables. The common five factors are environment (factor 1), services (factor 2), quality of crops (factor 3), price (factor 4) and safety and friendly use (factor 5).

5.1 Findings

First of all, the respondents from using vermi-fertilizer are studied. According the respondents by the demographic, 63 percent of the respondents are male and 37 percent of respondents are female. All of the respondent's 100 percent are Burmese and Buddhist. The majorities 50 percent of the respondents are 41-60 years old, 38.9 percent of the respondents are 21-40, while 10.4 percent of the respondents are over 60 years old and 0.7percent of respondents are 20 or less than 20 years old. The minimum age of the respondents is 18 years and the maximum age of the respondents is 73 years. Minimum household member is 2 and maximum household member is 10 in the total household 298. Almost 57 percent of the respondents' family has 2-4 household members, about 41 percent of the respondents' family has 5-7 household members and about 2 percent of the respondents' family has 8-10 household member.

The study found that the Socio-Economic characteristics of the respondents. Almost 60 percent of the respondents are Primary level, 25 percent are secondary level, 11 percent are high school level, and 1 percent are illiterates and other. Only 1 percent are under graduates and 2 percent are graduates. Obviously, 95.97 percent of the respondents are dealing with only farming. And the rest few percentages 4.03 percent of the respondents are dealing with both for farming and other jobs such as hair dressing, livestock, trading, driving, serving as government staff, and serving as

daily workers and so on. In classification of the annual total household income, the minimum annual household income is MMK 300,000 and maximum annual household income is MMK 30,000,000. The largest group included those with and annual household income of MMK 1,100,000 to MMK 2,000,000 (31.6%), followed by MMK 2,100,000 to MMK 3,000,000 (20.1%), MMK 1,000,000 or below (10.7%), MMK 3,100,000 to MMK 4,000,000 (14.1%) and MMK 4,100,000 to MMK 5,000,000 (14.1%). Only 9.4% of the respondents had and annual household income of MMK above 5,000,000. According to the annual total household expenditure, the minimum annual household expenditure is MMK 100,000 and maximum annual household expenditure is MMK12,000,000.

The study found that the plantation and need information of the crops. The most respondent's 25.30 percent plant bean by using vermi-fertilizers, followed by paddy 19.73 percent, sesame 16.53 percent, onion 12.19 percent, cotton 8.37 percent, vegetable 8.16 percent, chilly 5.57 percent, corn 2.38 percent, tomato 0.93 percent, sugarcane 0.21 percent, flower 0.21 percent, betel 0.21 percent and tobacco 0.21 percent. Most farmers have been used chemical fertilizer and they have got awareness by company staff to use bio fertilizer. The respondents are dealing with farming for selling by using 43.73 percent of vermi-fertilizers, and 0.64 percent of respondents are growing the above mentioned to consume while 55.63 percent of respondents are planting both for selling and providing their needs for consumption. Most of the respondent's 95.77 percent sell crops through agencies/broker house, and 4.23 percent of respondents sell directly to markets. The respondents get the information of crops through their networks by 64.51 percent, 15.27 percent through television, 13.10 percent from radio broadcasting, 5.44 percent on internet, 1.69 percent from journals/newspapers.

The study found that the respondents used vermi-fertilizer by 48.92 percent exclusively while 51.08 percent of the respondents mixed with chemical fertilizers. 72.27 percent of respondents used chemical fertilizers and 27.73 percent of respondents used natural fertilizers before they use vermi-fertilizers. 79.37 percent of the respondents are raised awareness through marketing staff for the information of vermi-fertilizers. 17.78 percent of the respondents are known from the other peoples and 2.54 percent of respondent are known through bill boards, and 0.32 percent of respondents are through on air. almost 95.65 percent of the respondents purchased

vermi-fertilizers from the village agents, 3.68 percent of the respondents purchased from township agents and 0.67 percent of the respondents purchase from the shop. Minimum spending of vermi-liquid and vermi-compost for one season by respondents is MMK 5000 and maximum usage of vermi-liquid and vermi-compost for one season by respondents is MMK 547,500.

In factor analysis of farmer's satisfaction, it was created correlated variable composites from the 23 attributes and identified a small set of dimensions. The initial solution generated by principal component method, the factors with eigenvalues greater than or equal to 1.0 and attributes with factor loadings greater than 0.3 are reported. From the varimax-rotated factor matrix, five factors with 22 variables.

In the KMO and Bartlett's Test, the factor analysis is suitable to analyze the survey data since the Kaiser-Meyer-Olkin (KMO) Measure of sampling adequacy is 0.873 and the significant of Bartlett's Test of Sphericity is 0.000. Base on the reliability analysis, the Cronbach's alpha of each factor is determined to test the reliability and internal consistency of each factor. The results of the alpha coefficients for the overall perception of attributes is 0.900. The results are reliable for accepting the reliability test.

In the correlation analysis, the correlation between expenditure on vermi-fertilizer and the Environment factor is positive and significant at the 0.01 level. The expenditure on vermi-fertilizer increased according to the farmer's satisfaction of the benefits on environment include improving soil quality, recovering and reducing soil degradation, preventing danger of insect, and making fresh air. Also owning of land acres factor is positive and significant at the 0.01 level. As it is expected, the expenditure on vermi-fertilizer increased based on famers who owned many acres of land. The other four factors include services factor, quality of crops factor, price factor and safety and friendly use factor are not significant at the 0.01 level.

In multiple regression analysis, the main result of the research is existence of the positive relationship between environment and expenditure on vermi-fertilizers. This mean that the farmers satisfaction the effect of environment increased, the expenditure on the vermi-fertilizers will be increased. Because of the good impact of using vermi-fertilizers as improvement of soil quality and environmental conservation, the farmers become more use of vermi-fertilizers rather than the previous time. As a result, it can be assumed that the sale volume of vermi-fertilizers

can be increased. Being use of the vermi-fertilizers makes the improvement of soil and increase yields of the crops, and get the improvement of the products' quality.

The farmers' owned land acres also significant positive relationship with the expenditure on vermi-fertilizers. It is found that famers those who have more land use more vermi-fertilizers, and it can be assumed that the amount of using vermi-fertilizers per farmer are based on the land what they have.

There may be significant for the factors such as services, quality of crops, price, safety and friendly uses. But there are no evidences of significance according to the analysis. To review the payment system to be easy and quality improvement. There needs to review the description for easy use of the products, packaging and instruction for use of products. It is more suitable to use the vermi-fertilizers for long term in the aspects of price and quality, and the impact will be contributed in the sustainable development.

5.2 Suggestions and Recommendations

As per the main result of the research, farmer spent for the vermi-fertilizers for the reason of recovering soil degradation, improving soil quality, protect environmental conservation, prevent effects of insect, improve air quality to be fresh which support healthier life for human being and other specifies. Therefore, it needs to be used the vermi-fertilizers which provide numerous benefits to the agriculture sector; including farmers and consumers; and its environment for the sustainable agriculture. Myanmar is the agriculture country and the fertilizers are used to get increased yields. Although the chemical fertilizers get high yields, it is not suitable to be used for the long time because of their impact for soil and environmental degradation. Bio-fertilizers, vermi-fertilizers; can be mixed with chemical fertilizers in the GAP (Good Agriculture Practices) system which support increased yield and reduce the soil and environmental degradation. And this system is being used in many places in the world so that to get sufficient food and food security. The vermi-fertilizers should be used significantly as it has numerous benefits for the farmers, consumers and community as a whole.

5.3 Further Studies

This study has limitations that need to be addressed in further research. This study is focused on the farmer's satisfaction on use of vermi-fertilizers. And it needs to study other types of organic fertilizer as well. The investigation was conducted in only five townships in Magway Division. Similar studies may be undertaken in other districts, so that influence can be generalized to a greater extent. Other studies should be analyzed the utilization of the vermi-fertilizers on specific crops as to develop the study to compare among the diversities of crops. It needs to express the control factor, owning land acres has an interactive effect on expenditure as a satisfaction factors.

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APPENDICES

Appendix (1) Survey Questionnaire

Q1	How do you understand about Bio fertilizers? …….....……
Q2	Name of Respondent ….....
Q3	Gender of Respondent Male….....(1) Female….....(2)
Q4	Race of Respondent ….....
Q5	Religion of Respondent ….....
Q6	Age of Respondent ….....
Q7	Total household members ….....
Q8	Educational Qualification Illiterate/No education …..(1) Monastic education, literate/Primary level …..(2) Secondary level …..(3) High school …..(4) Under Graduate …..(5) Graduate …..(6) Other …..(7)
Q9	Career of Respondent ….....
Q10	Family annual income ……
Q11	Family annual expenditure……
Q12	Do you use vermi-liquid and vermi-compost? Yes …..(1) No …..(2)
Q13	(If Yes, How do you know about vermi liquid and vermi compost?) Awareness …..(1) Information received from other people …..(2) Radio …..(3) Bill Board ……..(4) Other (Pls specify) …..(5)

Q14	What type of fertilizer did you use before using vermi-fertilizers? Natural Fertilizer ….....(1) Chemical Fertilizer ….....(2) Bio Fertilizer ….....(3) Other ….....(4)
A15	How do you use vermi-liqud and vermi-compost? Swanyee exclusively….....(1) Use by mixing with other fertilizers ….....(2)
Q16	Own land acre…….
Q17	Land acre being used Swanyee vermi-liquid and compost …….....
Q18	Land acre being used exclusively Swanyee vermi-liquid and compost ……..
Q19	How long have you been using Swanyee vermi-liquid and compost? (month)……
Q20	Where do you usually purchase vermi-liquid and compost from? Shop …..... (1) Village Agent ….....(2) Township Agent ….....(3) Company ….....(4) Other ….....(5)
Q21	What type of crops/plants do you grow? Paddy ….....(1) Bean ….....(2) sesame ….....(3) Onion ….....(4) Chilli ….....(5) Cotton ….....(6) Vagatable ….....(7) Other ….....(8)

Q22	How many times do you plant in a year? one season ….....(1) two season…..... (2) three season …..... (3)
Q23	How many liters of vermi-liquid and bags of vermi-compost do you use? one acre……(Liter) ….....(Kilogram) one season…… …(Liter) …..... .....(Kilogram) one year……..……..…….(Liter) ….....(Kilogram)
Q24	How much do you spend on vermi-liquid and compost? one acra (Kyat)…….....…… one season (Kyat)…….....…. one year (Kyat)…….....…….
Q25	What is the purpose of product? to sale …..... (1) to consume ….....(2) both (to sale, to consume) …..... (3) Other …..... (4)
Q26	Who are your customers? Through agencies/Broker house ….....(1) Direct….....(2) Other ….....(3)
Q27	Where do you get information about crop? Journal/Newspaper ….....(1) Television ….....(2) Radio ….....(3) Internet ….....(4) Friends ….....(5)

Q28	Advantages of using vermi liquid and compost.					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Production rate gets better	1	2	3	4	5
	The Production rate is not decreased	1	2	3	4	5
	Improved seeds quality	1	2	3	4	5
	Improved product quality	1	2	3	4	5
	Good color quality of Crops	1	2	3	4	5
	Long storage life	1	2	3	4	5
	Fair price	1	2	3	4	5
	Matching the price with quality	1	2	3	4	5
	Economy	1	2	3	4	5
	Safe for consumers	1	2	3	4	5
	Easy to use	1	2	3	4	5
	Give natural taste to crops	1	2	3	4	5
	Get good price	1	2	3	4	5
	Provide improving soil quality	1	2	3	4	5
	Make soil quality for long term use	1	2	3	4	5
	Recover soil degradation	1	2	3	4	5
	By using long-term, prevent danger of insect	1	2	3	4	5
	Protect environmental	1	2	3	4	5
	Make air to be fresh	1	2	3	4	5
	By using long-term, reduce soil degradation	1	2	3	4	5
	Good payment system	1	2	3	4	5
	Products arrive in the right time	1	2	3	4	5
	Convenient transportation	1	2	3	4	5
	Good communication between sellers and users	1	2	3	4	5
	Good dealing with issues	1	2	3	4	5
Q29	Any comments on the vermi-liquid and vermi-compost. ……...……. ……...……					

Appendix (2) Percentage of the use of Fertilizer and crops

Variable	Percent (%)
Vermi-liquid and vermi-compost information from	
Awareness	79.37%
other people	17.78%
Radio	0.32%
Bill Board	2.54%
Fertilizers before using vermi-fertilizers	
Natural Fertilizer	27.73%
Chemical Fertilizer	72.27%
Using vermi with another things	
vermi Fertilizer exclusively	48.92%
Mixing with other fertilizers	51.08%
Purchase from	
Shop	.67%
Village Agent	95.65%
Township Agent	3.68%
Type of crops	
Paddy	19.73%
Bean	25.30%
Sesame	16.53%
Onion	12.19%
Chilli	5.57%
Cotton	8.37%
Vagatable	8.16%
Corn	2.38%
Sugarcane	0.21%
Tomato	0.93%
Flower	0.21%
Betel	0.21%
Tobacco	0.21%
Purpose	
to sale	43.73%
to consume	0.64%
both (to sale, to consume)	55.63%
Customers	
Through agencies/Broker house	95.77%
Direct	4.23%
Information sources for crops	
Journal/Newspaper	1.69%
Television	15.27%
Radio	13.10%
Internet	5.44%
Friends	64.51%

Appendix (3) Factor Analysis Results for Perception of Attributes

Attributes	Estimated Factor Loadings					Communalities
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	
Environment						
Make soil quality for long term use	0.895					0.823
Recover soil degradation	0.85					0.77
Provide improving soil quality	0.821					0.704
Protect environmental	0.743					0.603
By using long-term, reduce soil degradation	0.73					0.599
By using long-term, prevent danger of insect	0.708					0.637
Make air to be fresh	0.658					0.616
Service						
Good communication between sellers and users		0.904				0.853
Convenient transportation		0.9				0.85
Products arrive in the right time		0.89				0.839
Good payment system		0.76				0.656
Good dealing with issues		0.615				0.478
Quality of Crops						
Improved seeds quality			0.777			0.659
Improved product quality			0.764			0.687
Production rate gets better			0.708			0.671
Good colour quality of Crops			0.707			0.617
Long storage life			0.629			0.453
The Production rate is not decreased			0.607			0.609
Price						
Fair price				0.832		0.723
Matching the price with quality				0.741		0.7

Safety and friendly use Safe for consumers Easy to use					0.796 0.77	0.741 0.762
Eigenvalue	7.507	3.383	1.963	1.275	1.141	
% of Variance	32.641	14.707	8.535	5.545	4.96	
Cumulative % of Variance	32.641	47.347	55.882	61.427	66.387	
Number of items (Total 22)	7	5	6	2	2	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

Gender of the Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	188	63.1	63.1	63.1
	Female	110	36.9	36.9	100.0
	Total	298	100.0	100.0	

Race of the Respondent

	Frequency	Percent	Valid Percent	Cumulative Percent
Burmese	298	100.0	100.0	100.0

Religion of the Respondent

	Frequency	Percent	Valid Percent	Cumulative Percent
Buddhist	298	100.0	100.0	100.0

Age of the Respondent

	N	Minimum	Maximum	Mean	Std. Deviation
Age of Respondent	298	18	73	44.78	11.311
Valid N (listwise)	298				

Household Member

	N	Minimum	Maximum	Mean	Std. Deviation
Total household members	298	2	10	4.43	1.347
Valid N (listwise)	298				

Educational Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Illiterate/No education	2	.7	.7	.7
	Monastic education, literate/Primary level	179	60.1	60.1	60.7
	Secondary level	74	24.8	24.8	85.6
	High school	32	10.7	10.7	96.3
	Under Graduate	4	1.3	1.3	97.7
	Graduate	5	1.7	1.7	99.3
	Other Ba Ka	2	.7	.7	100.0
	Total	298	100.0	100.0	

Family Income and Expediture

	N	Minimum	Maximum	Mean	Std. Deviation
Family annual income	298	300.0	30000.0	3198.658	2557.9228
Family Monthly income	298	25.0	1083.0	264.567	172.3462
Family annual expenditure	298	100.0	12000.0	2208.691	1670.3370
Family Monthly expenditure	298	8.0	1000.0	184.013	139.2142
Valid N (listwise)	298				

Career of Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farmer	286	96.0	96.0	96.0
	Farmer/Hair Dresser	1	.3	.3	96.3
	Farmer/Live Stock	3	1.0	1.0	97.3
	Farmer/Trade	3	1.0	1.0	98.3
	Farmer/Driver	1	.3	.3	98.7
	Farmer/Dependent	1	.3	.3	99.0
	Farmer/staffs	1	.3	.3	99.3
	Farmer/Teacher	1	.3	.3	99.7
	Farmer/Daily Worker	1	.3	.3	100.0
	Total	298	100.0	100.0	

$vermi Frequencies

		Responses		Percent of Cases
		N	Percent	
$vermi[a]	If Yes, How do you know about vermi liquid and vermi compost?Awareness	250	79.4%	83.9%
	If Yes, How do you know about vermi liquid and vermi compost?Information received from other people	56	17.8%	18.8%
	If Yes, How do you know about vermi liquid and vermi compost?Radio	1	.3%	.3%
	If Yes, How do you know about vermi liquid and vermi compost?Bill Board	8	2.5%	2.7%
Total		315	100.0%	105.7%

Plantation time

	N	Minimum	Maximum	Mean	Std. Deviation
How many times do you plant in a year?	298	1	3	2.17	.486
Valid N (listwise)	298				

Type of fertilizer Frequencies

		Responses		Percent of Cases
		N	Percent	
$type_fertilizer[a]	What type of fertilizer did you use before using vermi fertilizers? Natural Fertilizer	104	27.7%	34.9%
	What type of fertilizer did you use before using vermi fertilizers? Chemical Fertilizer	271	72.3%	90.9%
Total		375	100.0%	125.8%

a. Dichotomy group tabulated at value 1.

$Q15 Frequencies

		Responses		Percent of Cases
		N	Percent	
using vermi with another thing[a]	How do you use vermi liqud and vermi compost? Swanyee exclusively	158	48.9%	53.0%
	How do you use vermi liqud and vermi compost? Use by mixing with other fertilizers	165	51.1%	55.4%
Total		323	100.0%	108.4%

a. Dichotomy group tabulated at value 1.

Own Land Acre

	N	Minimum	Maximum	Mean	Std. Deviation
Own land acre	298	0.00	50.00	6.4673	5.64016
Land acre being used Swanyee vermi liquid and compost	298	0.0	12.0	2.178	1.6039
Land acre being used exclusively Swanyee vermi liquid and compost	298	0.0	12.0	.856	1.2966
Valid N (listwise)	298				

$Q20 Frequencies

		Responses		Percent of Cases
		N	Percent	
purchase[a]	Where do you usually purchase vermi liquid and compot from? Shop	2	.7%	.7%
	Where do you usually purchase vermi liquid and compot from? Village Agent	286	95.7%	96.0%
	Where do you usually purchase vermi liquid and compot from? Township Agent	11	3.7%	3.7%
Total		299	100.0%	100.3%

a. Dichotomy group tabulated at value 1.

$Q25 Frequencies

		Responses		Percent of Cases
		N	Percent	
purpose[a]	What is the purpose of product?to sale	136	43.7%	45.6%
	What is the purpose of product? to consume	2	.6%	.7%
	What is the purpose of product? both (to sale, to consume)	173	55.6%	58.1%
Total		311	100.0%	104.4%

a. Dichotomy group tabulated at value 1.

$Q26 Frequencies

		Responses		Percent of Cases
		N	Percent	
customers[a]	Who are your customers? Through agencies/Broker house	294	95.8%	98.7%
	Who are your customers? Direct	13	4.2%	4.4%
Total		307	100.0%	103.0%

$Q21 Frequencies

		Responses		Percent of Cases
		N	Percent	
$Q21[a]	What type of crops/plants do you grow? Paddy	191	19.7%	64.1%
	What type of crops/plants do you grow? Bean	245	25.3%	82.2%
	What type of crops/plants do you grow? Sesame	160	16.5%	53.7%
	What type of crops/plants do you grow? Onion	118	12.2%	39.6%
	What type of crops/plants do you grow? Chilli	54	5.6%	18.1%
	What type of crops/plants do you grow? Cotton	81	8.4%	27.2%
	What type of crops/plants do you grow? Vagatable	79	8.2%	26.5%
	What type of crops/plants do you grow? Corn	23	2.4%	7.7%
	What type of crops/plants do you grow? Sugar cain	2	0.2%	.7%
	What type of crops/plants do you grow? Tomato	9	0.9%	3.0%
	What type of crops/plants do you grow? Flower	2	0.2%	.7%
	What type of crops/plants do you grow? Betel	2	0.2%	.7%
	What type of crops/plants do you grow? Tobacco	2	0.2%	.7%
Total		968	100.0%	324.9%

a. Dichotomy group tabulated at value 1.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
How many liters of vermi liquid and bags of vermi compost do you use? one acre liter	298	0	22	6.08	1.852
How many liters of vermi liquid and bags of vermi compost do you use? one acre kg	298	0.0	100.0	24.282	25.6224
How many liters of vermi liquid and bags of vermi compost do you use? one season liter	298	0.0	72.0	12.859	9.3690
How many liters of vermi liquid and bags of vermi compost do you use? one season kg	298	0.0	750.0	34.799	60.8328
How many liters of vermi liquid and bags of vermi compost do you use? one year liter	298	0.0	132.0	17.708	16.7914
How many liters of vermi liquid and bags of vermi compost do you use? one year kg	298	0.0	750.0	40.319	72.3102
How much do you spend on vermi liquid and compost? one acre	298	5.0	90.0	30.003	16.4727
How much do you spend on vermi liquid and compost? one season	298	5.0	547.5	53.651	47.7553
How much do you spend on vermi liquid and compost? one year	298	5.0	645.0	69.438	70.2753
Valid N (listwise)	298				

$Q27 Frequencies

		Responses		Percent of Cases
		N	Percent	
inforamtion source[a]	Where do you get information about crop? Journal/Newspaper	7	1.7%	2.3%
	Where do you get information about crop? Television	62	15.3%	20.8%
	Where do you get information about crop? Radio	53	13.1%	17.8%
	Where do you get information about crop? Internet	22	5.4%	7.4%
	Where do you get information about crop? Friends	262	64.5%	87.9%
Total		406	100.0%	136.2%

a. Dichotomy group tabulated at value 1.

Reliability Statistics	
Cronbach's Alpha	N of Items
0.900	23

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.873
Bartlett's Test of Sphericity	Approx. Chi-Square	4118.903
	df	253
	Sig.	0.000

Communalities		
	Initial	Extraction
Production rate gets better	1.000	0.671
The Production rate is not decreased	1.000	0.609
Improved seeds quality	1.000	0.659
Improved product quality	1.000	0.687
Good colour quality of Crops	1.000	0.617
Long storage life	1.000	0.453
Fair price	1.000	0.723

Matching the price with quality	1.000	0.700
Safe for consumers	1.000	0.741
Easy to use	1.000	0.762
Provide improving soil quality	1.000	0.704
Make soil quality for long term use	1.000	0.823
Recover soil degradation	1.000	0.770
By using long-term, prevent danger of insect	1.000	0.637
Protect environmental	1.000	0.603
Make air to be fresh	1.000	0.616
By using long-term, reduce soil degradation	1.000	0.599
Good payment system	1.000	0.656
Products arrive in the right time	1.000	0.839
Convenient transportation	1.000	0.850
Good communication between sellers and users	1.000	0.853
Good dealing with issues	1.000	0.478
Get good price	1.000	0.217
Extraction Method: Principal Component Analysis.		

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.507	32.641	32.641	7.507	32.641	32.641	4.510	19.610	19.610
2	3.383	14.707	47.347	3.383	14.707	47.347	4.147	18.031	37.641
3	1.963	8.535	55.882	1.963	8.535	55.882	3.392	14.748	52.389
4	1.275	5.545	61.427	1.275	5.545	61.427	1.704	7.409	59.799
5	1.141	4.960	66.387	1.141	4.960	66.387	1.515	6.588	66.387
6	0.936	4.068	70.454						
7	0.898	3.906	74.360						
8	0.728	3.165	77.525						

9	0.687	2.988	80.513						
10	0.606	2.633	83.146						
11	0.507	2.206	85.352						
12	0.464	2.017	87.369						
13	0.421	1.831	89.200						
14	0.409	1.777	90.977						
15	0.383	1.663	92.641						
16	0.329	1.429	94.069						
17	0.302	1.314	95.384						
18	0.260	1.131	96.514						
19	0.233	1.013	97.527						
20	0.193	0.839	98.366						
21	0.153	0.665	99.032						
22	0.114	0.494	99.526						
23	0.109	0.474	100.000						
Extraction Method: Principal Component Analysis.									

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.325[a]	0.106	0.087	45.6236	0.106	5.734	6	291	0.000	2.132

a. Predictors: (Constant), Own land acre, REGR factor score 3 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 5 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

b. Dependent Variable: How much do you spend on vermi liquid and compost? one season ('000)

Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
Make soil quality for long term use	0.895				
Recover soil degradation	0.850				
Provide improving soil quality	0.821				
Protect environmental	0.743				
By using long-term, reduce soil degradation	0.730				
By using long-term, prevent danger of insect	0.708				
Make air to be fresh	0.658				
Good communication between sellers and users		0.904			
Convenient transportation		0.900			
Products arrive in the right time		0.890			
Good payment system		0.760			
Good dealing with issues		0.615			
Improved seeds quality			0.777		
Improved product quality			0.764		
Production rate gets better		0.353	0.708		
Good colour quality of Crops			0.707		
Long storage life			0.629		
The Production rate is not decreased		0.461	0.607		
Fair price				0.832	
Matching the price with quality				0.741	
Get good price					
Safe for consumers					0.796
Easy to use		0.392			0.770
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.					
a. Rotation converged in 5 iterations.					

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	71608.516	6	11934.753	5.734	.000[b]
	Residual	605720.188	291	2081.513		
	Total	677328.705	297			

a. Dependent Variable: How much do you spend on vermi liquid and compost? one season ('000)

b. Predictors: (Constant), Own land acre, REGR factor score 3 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 5 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	41.507	4.041		10.271	0.000	33.553	49.461		
	REGR factor score 1 for analysis 1	11.891	2.655	0.249	4.479	0.000	6.665	17.116	0.994	1.006
	REGR factor score 2 for analysis 1	0.331	2.654	0.007	0.125	0.901	-4.892	5.554	0.995	1.005
	REGR factor score 3 for analysis 1	2.458	2.647	0.051	0.929	0.354	-2.752	7.669	1.000	1.000
	REGR factor score 4 for analysis 1	-0.277	2.647	-0.006	-0.104	0.917	-5.487	4.934	1.000	1.000

	REGR factor score 5 for analysis 1	0.838	2.652	0.018	0.316	0.752	-4.382	6.058	0.996	1.004
	Own land acre	1.878	0.473	0.222	3.972	0.000	0.947	2.808	0.986	1.014
a. Dependent Variable: How much do you spend on vermi liquid and compost? one season ('000)										

Correlations

		How much do you spend on vermi liquid and compost? one season ('000)	REGR factor score 1 for analysis 1
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	.232**
	Sig. (2-tailed)		0.000
	N	298	298
REGR factor score 1 for analysis 1	Pearson Correlation	.232**	1
	Sig. (2-tailed)	0.000	
	N	298	298
**. Correlation is significant at the 0.01 level (2-tailed).			

Correlations

		How much do you spend on vermi liquid and compost? one season ('000)	REGR factor score 2 for analysis 1
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	0.022
	Sig. (2-tailed)		0.704
	N	298	298
REGR factor score 2 for analysis 1	Pearson Correlation	0.022	1
	Sig. (2-tailed)	0.704	
	N	298	298

Correlations			
		How much do you spend on vermi liquid and compost? one season ('000)	REGR factor score 3 for analysis 1
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	0.052
	Sig. (2-tailed)		0.368
	N	298	298
REGR factor score 3 for analysis 1	Pearson Correlation	0.052	1
	Sig. (2-tailed)	0.368	
	N	298	298

Correlations			
		How much do you spend on vermi liquid and compost? one season ('000)	REGR factor score 4 for analysis 1
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	-0.004
	Sig. (2-tailed)		0.941
	N	298	298
REGR factor score 4 for analysis 1	Pearson Correlation	-0.004	1
	Sig. (2-tailed)	0.941	
	N	298	298

Correlations			
		How much do you spend on vermi liquid and compost? one season ('000)	REGR factor score 5 for analysis 1
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	0.004
	Sig. (2-tailed)		0.944
	N	298	298
REGR factor score 5 for analysis 1	Pearson Correlation	0.004	1
	Sig. (2-tailed)	0.944	
	N	298	298

Correlations			
		How much do you spend on vermi liquid and compost? one season ('000)	Own land acre
How much do you spend on vermi liquid and compost? one season ('000)	Pearson Correlation	1	.203**
	Sig. (2-tailed)		0.000
	N	298	298
Own land acre	Pearson Correlation	.203**	1
	Sig. (2-tailed)	0.000	
	N	298	298
**. Correlation is significant at the 0.01 level (2-tailed).			